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TOOLING FOR THE NEWER METALS

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Associate Editor

EACH YEAR brings a wider use of special alloys which demand study to anticipate their influence on the tool design of the future

THE ENTERPRISING machine designer of today looks to the metallurgist for answers to many of his problems. Cast iron and carbon steel still fill a variety of needs, but far from all of them. Prior to the World War, these two materials together with bronze, brass, and babbitt, used for bearing or rust-resisting purposes, formed by far the greater percentage of parts handled in the average machine shop. Alloy steels were not unknown, it is true. The rapidly growing automotive industry had adopted them for a number of parts and had standardized many of them under the familiar S.A.E. specifications. Other industries were showing interest in the unusual characteristics of these steels. Then the War, with its novel demands on manufacturing activities and its stimulation of aircraft construction, aroused widespread interest in these new materials.

We are now in an era of special alloys—elements formerly mentioned seldom outside the chemical laboratory have gained common acceptance. Chromium, nickel, silicon, manganese, cobalt, vanadium, aluminum, and many others are familiar to the machine shop. They have been pressed into service to meet more exacting demands for extraordinary physical properties. Unusual hardness, toughness, lightness, ductility, or rust- or chemical-resistant properties are required in a degree that neither cast iron nor carbon steel can meet. New advances in material composition are being recorded almost daily—new uses are constantly being found for these new materials. Even with the remarkable progress already achieved in metallurgy, it is probable that the surface has as yet merely been scratched.

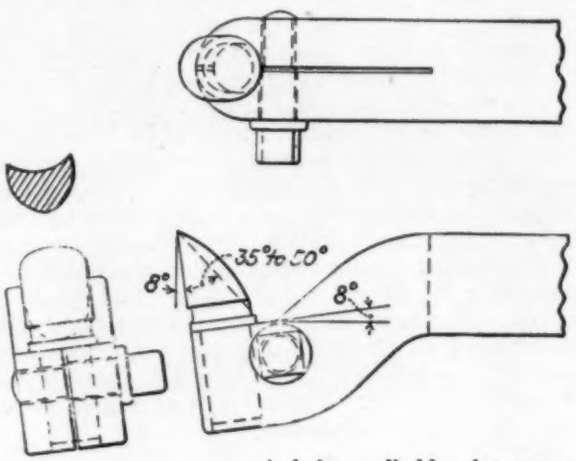
The growing diversification in material usage has complicated the problems of the tool designer and the machine tool builder. Thanks to Frederick W. Taylor and his collaborators, the correct cutting angles for cast iron and steel were determined years ago after careful experimentation. The newer metals possess individual characteristics which necessitate modifications in these tool standards if satisfactory results are to be obtained. Tools for machining free-cutting brass, for example, need little if any top and side rake; they may be ground on a medium coarse wheel and are often used without any cutting compound. For mild carbon steel, the top and side rakes are increased, a medium abrasive wheel is used, and the use of soluble oil is found advantageous. In some instances, especially for thread cutting, paraffin-base coolants are preferred. Aluminum and its alloys require tools with appreciably more side and top rake; keen cutting edges, obtained by grinding on fine wheels and often supplemented by hand stoning with an oilstone, are important. Cutting compounds should be employed wherever possible, equal quantities of lard oil and kerosene being satisfactory for general use. There is a noticeable similarity between tools for machining aluminum and those for hardwoods.

A suitable tool is one having a front clearance of about 6 deg., a top rake of from 30 to 50 deg., giving a total

Ewing Galloway

WINGED HARBINGERS OF METAL PROGRESS

angle at the cutting edge of from 36 to 56 deg. A side rake of from 10 to 20 deg. is proper. If a blunt-nosed tool, suitable for brass, is used for aluminum alloys, the chip is not sheared from the piece but is pulled from the work ahead of the cutting tool, leaving a rough surface. As the cut is continued, small particles of the metal adhere to the tool forming a projection of hard-worked aluminum, which tends to function as a cutting edge. This projection, while considerably harder than the work being machined, is not sufficiently hard to cut cleanly. It produces excessive heat both in the tool and the work through friction. When the angle of the cutting edge



A lathe toolholder for use with aluminum, showing the high top rake angle and adjustable toolbit

is small enough, little if any metal will stick to it, and chips will be cut from the work rather than torn or pried off. To obtain a smooth surface, the chips should curl as little as possible.

Pure aluminum and many of its alloys may be machined with a mirrorlike finish, but the surface is easily scratched if the chip comes in contact with it. There is considerable difference in the machinability of aluminum alloys both in the cast and wrought conditions. The aluminum-silicon alloys are perhaps the most difficult to machine, while those of the duralumin type, heat-treated, have the best machining properties.

A convenient form of turning tool for aluminum and its alloys is illustrated. The toolbit is made from round tool steel or high-speed steel stock, which may be conveniently ground in the chuck of a grinding machine. The bit may be readily adjusted angularly to suit working conditions. This tool, like most others proper for machining aluminum, tends to produce continuous chips. Parting tools for aluminum alloys should have from 12 to 20 deg. top rake and should be stoned so their cutting edges are keen and smooth. A front clearance angle of 3 or 4 deg. is about right. Facing tools should be ground to have a side rake about equal to the top rake of turning tools. Circular forming tools, such as are used in automatic screw machines, are difficult to design for machining aluminum properly. The best results are obtained by using a roughing tool first and following with a light finishing cut with the forming tool. The toolbit shown for turning may be adapted for planer or shaper use by a modified tool-holder. For heavy roughing cuts on a planer a side-cutting tool is superior.

Milling cutters of the coarse-toothed helical type with a considerable top rake are best for aluminum and its alloys. Nicked edges serve to decrease chip size. Taps of the helical-fluted ground-thread type will produce smooth and accurate threads. For producing a right-hand thread, the flute should be a right-hand helix similar to that used in an ordinary twist drill. In fact, a very satisfactory tap may be made by chasing threads in an annealed tool steel twist drill and rehardening it. It has been found advantageous, especially in screw machine work, to grind a top rake back of the lands, so there will be less tendency to seize when backing out. Slightly oversize taps aid in maintaining the required dimensions as aluminum has a lower modulus of elasticity and greater recoverance than steel. Ordinary twist drills may give trouble with aluminum. For some purposes, single-fluted drills such as are used for hardwood, are superior to the standard form. A still better drill has a helix angle of about 47 deg., giving it more twists per inch. Helical-fluted reamers give by far the best results.

Aluminum and its alloys may be machined to best advantage at comparatively high speeds and light feeds. Speeds of from 500 to 800 ft. per min. are possible with ordinary carbon steel tools, and these may be exceeded with high-speed steel. Feeds range from a few thousandths to as much as $\frac{1}{4}$ in. Feeds and speeds vary with the type of tool, the coolant used, and the machine tool.

A GREAT deal of interest is at present directed toward the corrosion-resistant steels, of late applied to a wide range of uses. Some confusion exists concerning these alloys because of the number of distinct types now manufactured. In general, there are three groups of these steels: those in which the alpha chrome-ferrite predominates, those in which the delta chrome-ferrite predominates, and the austenitic steels. All straight chromium steels are hard to machine because the chips tend to adhere to the tool. A mechanical correction for this is to increase the rake angle in the tool so the chips will skid off instead of piling up. The delta steels machine somewhat more freely than the alpha, while the austenitic group presents the most difficult problem. This last group embraces steels commercially designated by a number of names, such as Stainless Steel, Allegheny Metal, and Enduro. These are characterized by a high chromium content, 16.5 to 20 per cent, 7 to 10 per cent of nickel, and carbon usually under 0.20 per cent.

These metals cannot be heat-treated to produce definite physical properties but are unusually susceptible to hot and cold working. The metal has a tendency to flow and drag under cut. The work-hardening property makes it important to avoid any method of machining that will work the metal ahead of the cut as this may increase the hardness to an extent that will make the operation impossible. For example, drilling should be done with a high-speed drill ground somewhat flatter than for machine steel. It is necessary to exert sufficient pressure on the drill to make it cut all the time as a few revolutions without cutting hardens the material. Austenitic steels are said to drill better if the drill is ground with one lip longer than the other, so it cuts mostly on one side. The work should be backed up in a manner that will permit the drill to cut all the way through without pushing the metal away from the point, as this will cause rapid heating. A cast-iron backing plate will perform this service satisfactorily. The drill should be kept cool by immersing it in water after each hole. For deep hole drilling, the use of a compound of one pound of sulphur to one gallon of lard oil is advantageous. Laying out should

be done with a triangular-nosed center punch taking care not to mark deeper than necessary; otherwise, the metal will work-harden, making the drill difficult to start.

The high tensile strength of austenitic steels, together with their work-hardening properties, make it necessary to use more power in cutting than for other metals. The best results are obtained with slow cutting speeds and moderately heavy feeds. Cutting speeds should not be more than half of those used for mild carbon steels. Tools should be ground with a steep side and lip rake and must be kept sharp. The grinding of corrosion-resistant steels should be done wet to prevent undue heating of the metal. The use of a freshly dressed wheel will prevent contamination arising from the presence of other metals which may be lodged in its surface.

AN interesting development in chromium steels is the search for compositions more readily machinable. Carpenter Stainless No. 5 accomplishes this by the inclusion of zirconium sulphide, which is said to prevent chips from sticking to the tool, thus making it freely machinable.

Because of their excellent wear-resistant properties, high-manganese steels serve many important needs, but the difficulty in machining them on a commercial scale has somewhat retarded their use. Much of the forming of high-manganese steels is done by grinding; holes are made by coring, punching, or burning with a blowtorch. However, this material has recently been drilled successfully by using twist drills made of cobalt high-speed steel. It has been found advisable to warm the drill point before cutting; some users heat the manganese steel itself to about 500 deg. F. The drill speed should be between 13 and 15 ft. per min., and the feed from 0.003 to 0.010 in. per revolution. Coolants or lubricants should not be employed. The hole must be drilled in one continuous cut, every precaution being taken not to allow the drill to idle in the metal before or during the cut. When the drill breaks through, manganese steel has a tendency to spin which causes excessive heating.

Drills for manganese steel should be ground with a point angle of about 68 deg., a cone angle of 120 deg. and a lip clearance of from 6 to 8 deg. It has been found desirable to grind a flat on the lips of the drill along the flutes to reduce the rake angle and to thin the web to about one-half its usual section. In performing this work, the drill should not be given a negative rake which will blunt its cutting edge.

A sturdy drilling machine with a powerful, positive feed, is required for machining manganese steel. When a radial drill press is used, the work must be placed near the column to secure the maximum rigidity. Because of the tremendous pressure exerted by the tool when cutting, the work must be firmly held in place.

In considering the development of ferrous metals, that of cast iron should not be overlooked. The gray iron castings of today are quite a different product from the pre-war variety. The addition of steel scrap to the cupola charge, together with nickel or other alloying agents, has produced a close-grained metal with increased strength and freedom from sponginess. Troublesome occluded oxides have been brought under control. These advantages have been gained without serious problems of machinability by control of the silicon and manganese contents.

Monel metal, characterized by its resistance to many forms of corrosion, is furnished in a variety of specifications which vary with the content of carbon, silicon, and manganese. It is important to select the type suitable for the particular use to which it will be put. The machining properties of Monel differ from those of other materials and may prove troublesome unless the inherent qualities of this metal are borne in mind. For lathe work, either of two cutting tools permits the use of high cutting speeds with a minimum of grinding. Sharp cutting edges are best obtained by grinding with a large top rake or a combined top and side rake. The first tool is ground with a 13-deg. clearance angle and a 19 to 23-deg. top rake. The cutting edge is rounded and the nose tapered gradually from the side of the tool at an angle of 9 deg. The second tool has a 6-deg. clearance angle, an 8-deg. top rake and a 14-deg. side rake. Both tools cut cleanly, and easily rid themselves of the long, tough chips characteristic of Monel metal. Threading tools for Monel, on account of their pointed cutting edges, have more tendency to crumble. For this reason, they are ground with a smaller top rake, about 9 deg., and a clearance angle of 12 deg. The point is of course ground for the shape of thread desired.

MONEL is susceptible to work-hardening much the same as is austenitic steel. Toolbits must, therefore, have clearance angles which preclude the possibility of rubbing the flank against the work. Most toolholders are designed to provide this clearance. It has been found that properly tempering the tool after hardening increases the life of the cutting edge. This gives it the tough surface desired, since Monel is a tough rather than a hard metal. The essential difference in the structure between cast and drawn Monel metal is in the structure of the outside surface; cast Monel has a particularly tough outer skin which subjects the cutting edge of the tool to a severe strain. Hence cutting tools for castings may be blunter than those described—they may not cut quite as cleanly but are better adapted to resist the hard knocks encountered in cutting through the skin of the metal. Slightly slower cutting speeds are needed for cast Monel, a good average being 60 ft. per min. with a $\frac{1}{4}$-in. cut and $\frac{1}{32}$-in. feed. Rolled Monel may be machined at 10 ft. per min. faster with the same cut and feed. Other feed and speed combinations are given in the accompanying table. The use of a coolant materially aids the machining of Monel, a 10 to 1 solution of soluble oil having been found effective.

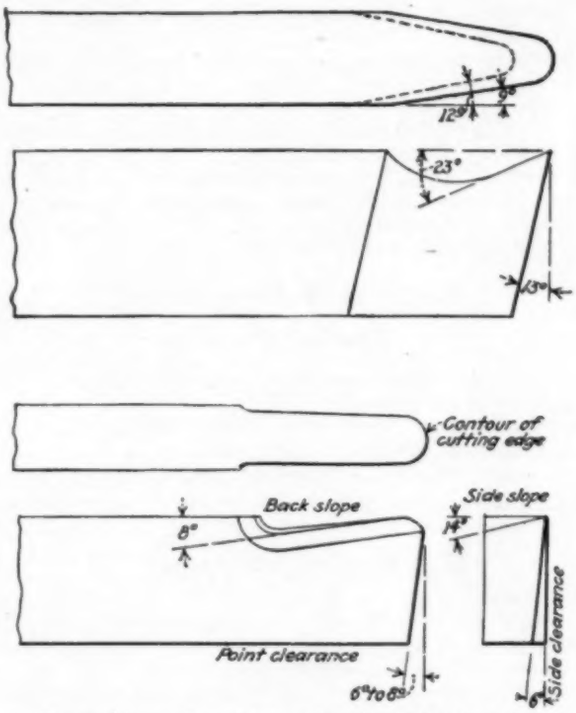
Monel metal may be satisfactorily drilled with either a carbon steel or high-speed steel twist drill. There is no advantage in departing from standard twist drill clearance and cutting angles except possibly to use an extra back taper to prevent gumming of the material. For high-speed drills with a 28 to 32 deg. helix angle, 50 ft. per min. with 0.003 in. feed per revolution is a good average. Carbon steel drills should be slowed down to

Feeds and Speeds for Turning Monel Metal

Cut (inches)		1/64		1/32			1/16			1/8				1/4		
Feed (inches)		1/64	1/32	1/64	1/32	1/16	1/64	1/32	1/16	1/64	1/32	1/16	1/8	1/32	1/16	1/8
Cutting Speed in Ft. per Minute	Cast	150	120	100	90	75	85	70	50	75	60	45	40	50	40	30
	Rolled	170	140	115	100	85	95	80	55	85	70	50	45	55	45	35

30 ft. per min. Helical-fluted reamers are best and should be fed slowly into the work. If too large a cut is taken at too high a speed, Monel may tear and wedge between the cutting edges. The principle of sharp edges is also applicable to milling cutters. Tooth spacing will vary according to the diameter and kind of cutter. For plain cutters, the teeth should be ground at a slight taper, widest at the edge, to prevent binding and tearing of the metal; an undercut has been found to be beneficial. For general milling practice, a speed of from 70 to 80 ft. per min. may be used with $\frac{1}{8}$-in. cut and from 0.005 to 0.010-in. feed per revolution, though these figures depend largely on the strength of the machine. It is advantageous to use tools with a high rake angle. For slot milling, staggered-tooth cutters are best employed since these give the greatest clearance. Cutters must be kept sharp; the edges wear away more rapidly than for steel and show a rough surface when they become dull.

ONE big difficulty in tapping is the tendency of the rough chip of Monel to stick in the flutes of the tap. It is best to use taps with two or three lands and shallow flutes to obtain additional strength. The lip should be ground back of the cutting edges, so it may better curl through the flutes and clear itself. When tapping through holes, it is good practice to grind the cutting edge on an angle of from 10 to 15 deg. to the axis of the tap with a chamfer of 4 to 5 threads. From



The problem of machining Monel metal is largely solved by attention to tool grinding; these turning tools illustrate the correct shapes

15 to 20 ft. per min. is the best all around tapping speed. Either carbon steel or high-speed steel taps may be used. Gun taps are well suited to tapping Monel metal; these are designed with a decided hook back from the cutting edge and a 4-thread chamfer about 20 deg. to the axis of the tap. Tapping or die-cutting threads is facilitated by using Monel in the hard-drawn condition rather than soft annealed. Self-opening dies, ground with a positive rake, should be used where possible. Methods of grinding Monel do not differ materially from the practice followed with steel.

To cut efficiently the wide variety of materials now in use, the machine tool engineer has sought to incorporate greater flexibility into his designs rather than to confine them to a specific metal. He has increased the range and number of feed and speed combinations—usually effected without added complication and often with simplification by the exercise of engineering skill. To name one of many possible examples, the Cincinnati Bickford radial drill has increased the number of speeds between motor and spindle from 32 to 36 while reducing the number of intervening gears from 28 to 17. For some machines, flexibility in feed control has been solved through the application of hydraulics, securing an infinite number of steps within a given range. Sliding gears and spline shafts are widely employed for feed and speed changes in place of tumbler gears and ratchet mechanisms. A logical cycle is completed when machine tools themselves are constructed of the newer alloys in response to a demand originated in machining these metals. The Cincinnati milling machine uses an aluminum overarm support, while the S.A.E. steels have found common use in shafts and gears for the drive and feed trains.

Increased rigidity has been built into machine tools in answer to the more stringent demands placed upon them. This, in turn, has permitted increases in power; during the past 15 years the average motor recommendations for comparative sizes of machine tools are estimated to have increased 100 per cent. Anti-friction bearings, having won a place in machine tool design, aid in transmitting a greater percentage of the driving power to the tool or work spindle. Pump and piping systems have been added, flooding the cutter with coolant instead of supplying a meager amount. Many of these advantages may be considered as logical developments in the metal-working industry, not solely attributable to material diversification—still problems arising from cutting new metals have undoubtedly stimulated attention to the desirability for improvement.

In addition to their influence on design, the newer metals have altered the character of the equipment required by many manufacturing plants. Frequently these materials need special heat-treatment to develop fully the properties desired, necessitating the installation or enlargement of heat-treating departments. In consequence, the demand for furnaces, lead pots, and pyrometric instruments has grown. To finish the harder products, recourse is made to abrasives, which is reflected in the demand for all types of grinding equipment, cylindrical, internal, surface, centerless, and disk.

IN ATTEMPTING to look ahead for future developments, it should be borne in mind that many metallic elements are still little understood in respect to their alloying qualities. Others, like beryllium, need cheaper methods of production to make their advantages available on a commercial scale. In any event, it is logical to anticipate that metal alloys will continue to increase in popularity and variety. The time may not be far distant when the machine tool designer will need to go further than to adapt designs originally intended for machining cast iron and carbon steel. He may well make a careful study of the new alloys with the view of designing machines conforming more particularly to the characteristics peculiar to them.

NATIONAL METAL CONGRESS

American Society for Steel Treating

Monday Morning

CORROSION AND HEAT-RESISTANT NICKEL-COPPER-CHROMIUM CAST IRON—J. S. Vanick and P. D. Merica, International Nickel Company.

FATIGUE TESTS OF SMALL SPECIMENS WITH REFERENCE TO SIZE EFFECT—R. E. Peterson, Westinghouse Electric & Manufacturing Company.

PHYSICAL PROPERTIES OF FINE BOLTS—H. B. Pulsifer, Ferry Cap & Set Screw Company.

ELECTROLYTIC DECOMPOSITION OF CEMENTITE AND AUSTENITE—H. A. Schwartz, G. M. Guiler, and H. H. Johnson, National Malleable & Steel Castings Company.

Monday Afternoon

STRESSES AND CRACKS IN HARDENED AND GROUND STEEL—G. R. Brophy, General Electric Company.

CEMENTED TUNGSTEN CARBIDE—Gregory J. Comstock, Firth-Sterling Steel Company.

ESTIMATION OF INTERNAL STRESS IN QUENCHED HOLLOW CYLINDERS OF CARBON TOOL STEEL—O. V. Greene, Carpenter Steel Company.

COLD-HEADING DIE LIFE—A. S. Jameson, International Harvester Company.

EFFECTS OF PREQUENCHED TREATMENTS ON THE HARDNESS, BODY, AND STRUCTURE OF HARDENED TOOL STEEL—R. H. Harrington, General Electric Company.

Tuesday Afternoon

FORGING PRACTICE, U. S. NAVAL GUN FACTORY—S. L. Blankenship, Naval Gun Factory.

HEAT-TREATMENT FURNACES USED IN MANUFACTURE OF TELEPHONE EQUIPMENT—W. A. Timm, Western Electric Company.

SCALING OF STEEL AT FORGING TEMPERATURES—W. E. Jominy and D. W. Murphy, University of Michigan.

COPPER BRAZING IN HYDROGEN-ELECTRIC FURNACES—H. J. Webber, General Electric Company.

Wednesday Morning

OXYGEN IN STEEL—Dr. Marcus A. Grossmann, Republic Steel Corporation.

Wednesday Afternoon

RADIOGRAPHY BY THE USE OF GAMMA RAYS—R. F. Mehl, Naval Research Laboratories, G. E. Doan and C. S. Barrett.

CRITICAL RANGES IN PURE IRON-CARBON ALLOYS—R. H. Harrington, General Electric Company and W. P. Wood, University of Michigan.

RELATIONSHIP BETWEEN WELDED-ON OVERLAYS AND HEAT-TREATMENT—Miles C. Smith, Stoody Company.

TUNGSTEN CARBON SYSTEM—W. P. Sykes, General Electric Company.

CONCENTRATED PRESSURE AND ITS APPLICATIONS TO THE ROLLING PROCESS—Dr. A. Nadai, Westinghouse Electric & Manufacturing Company.

Thursday Morning

INFLUENCE OF NICKEL ON THE CHROMIUM-IRON-CARBON CONSTITUTIONAL DIAGRAM—V. N. Krivobok, Carnegie Institute of Technology, and M. A. Grossmann, Republic Steel Corporation.

STUDY OF A HIGH-CHROMIUM, LOW-CARBON STEEL—Arthur Phillips, Yale University, and R. W. Baker, Republic Steel Corporation.

CORROSION TEST FOR RESEARCH AND INSPECTION OF ALLOYS—W. R. Huey, E. I. DuPont de Nemours & Company.

NATURE OF THE NICKEL-CHROMIUM STAINLESS STEELS—Edgar C. Bain and Robert H. Aborn, U. S. Steel Corp.

Thursday Afternoon

PROCESS RELIABILITY IN STEEL MAKING—George A. Dornin, Gathmann Engineering Company.

TENSILE PROPERTIES OF CARBON STEEL CASTINGS—J. V. McRae, and R. L. Dowdell, Bureau of Standards.

CASTING GUNS BY THE CENTRIFUGAL PROCESS—Col. Tracy C. Dickson, Watertown Arsenal.

STEEL INGOTS—H. H. Ashdown, Irvine, Pa.

Friday Morning

NITRIDING IN PACKING MATERIALS AND AMMONIA—A. B. Kinzel and J. J. Egan, Union Carbide & Carbon Research Laboratories.

FURTHER INVESTIGATIONS IN NITRIDING—Robert Sergeson and H. J. Deal, Republic Steel Corporation.

NITRIDING THE LARGER FORGINGS—J. H. Higgins, Camden Forge Company.

NITRIDING FURNACES AND THEIR EQUIPMENT—W. J. Merten, Westinghouse Electric & Manufacturing Co.

MICROCHARACTER HARDNESS TESTER—C. H: Bierbaum, Lumen Bearing Company.

Friday Afternoon

RELATION OF STRUCTURE TO SURFACE HARDNESS OF A CASE-HARDENED STEEL—H. W. McQuaid and O. W. McMullan, Timken-Detroit Axle Company.

RECENT DEVELOPMENTS IN GAS CARBURIZATION—O. J. Wilbor and J. A. Comstock, Peoples Gas Light & Coke Company.

MODIFYING ACTION OF FERROSILICON UPON THE PROCESS OF CARBURIZATION—E. G. Mahin and F. J. Moots, Notre Dame University.

RESISTANCE OF STEELS TO ABRASION BY SAND—Samuel J. Rosenberg, Bureau of Standards.

METASTABLE EQUILIBRIUM IN HYPEREUTECTOID IRON-CARBON ALLOYS—A. A. Bates and D. E. Lawson, Case School of Applied Science, and H. A. Schwartz, National Malleable & Steel Castings Company.

American Welding Society

Tuesday Morning

WELDING OF STAINLESS STEEL—L. W. Hostettler, Allegheny Steel Company.

ARC WELDING OF ALUMINUM—W. M. Dunlap, Aluminum Company of America.

OXY-ACETYLENE WELDING OF CORROSION-RESISTING STEELS—W. B. Miller, Union Carbide & Carbon Research Laboratories.

Tuesday Afternoon

THE EXAMINATION OF WELDS BY THE X-RAY DIFFRACTION METHOD—J. T. Norton, Mass. Inst. of Technology.

FATIGUE INVESTIGATIONS OF WELDED JOINTS—G. E. Thornton, State College of Washington.

STRESS DISTRIBUTION IN SIDE-WELDED JOINTS—Walter H. Weiskopf and Milton Male.

Wednesday Morning

RESISTANCE WELDING OF BAR JOISTS—Frank Burton, Steel Joist Institute.

COST OF USING WELDING—Robert E. Kinkead, consulting engineer.

STRENGTH OF WELDED JOINTS IN TUBULAR MEMBERS FOR AIRCRAFT—H. L. Whittemore, Bureau of Standards.

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SYMPOSIUM ON TESTING OF WELDS—Papers by J. W. Owens, W. B. Miller, Andrew Vogel, C. H. Jennings, and G. E. Doan.

TRIP TO HAWTHORNE WORKS, WESTERN ELECTRIC CO.

—Program of Technical Sessions

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APPLICATION OF FUSION WELDING TO PRESSURE VESSELS—J. C. Hodge, Babcock & Wilcox Company.

PHYSICAL PROPERTIES OF ELECTRICALLY WELDED TUBING—J. S. Adelson, E. O. Sequist, and H. L. Whittemore, U. S. Bureau of Standards.

MAGNETIC TESTING OF BUTT WELDS—T. R. Watts, Westinghouse Electric & Manufacturing Company.

Friday Morning

DOUBLE LENGTHENING RAILROAD RAILS—L. C. Ryan, manager, Track Dept., Oxweld Railroad Service Co.

THE POSSIBILITIES OF THE FURTHER DEVELOPMENT OF RAILROAD WELDING—G. W. Lieber, Supt. of Reclamation, Missouri, Kansas & Texas Railroad Company.

RECLAMATION OF BATTERED AND WORN ENDS OF RAILROAD TRACK—C. J. Bergunthal, Track Welding Supervisor, Southern Pacific Company.

ELIMINATION OF JOINT IN OPEN TRACK—J. H. Deppeler, Chief Engineer, Metal & Thermit Corporation.

Institute of Metals and Iron & Steel Divisions, A.I.M.E.

Monday Morning

SOME ASPECTS OF THE IRON ORE SITUATION — F. B. Richards.

BENEFICIATION OF IRON ORES FROM THE BLAST FURNACE VIEWPOINT—Ralph Sweetser.

RESISTANCE OF IRON ORES TO DECREPITATION AND MECHANICAL WORK—T. L. Joseph and E. P. Barrett.

Monday Afternoon

IRON ORE ROUND TABLE OF IRON & STEEL DIVISION.

Tuesday Afternoon

STUDIES UPON THE WIDMANSTATTEN. 1. Introduction. THE ALUMINUM-SILVER SYSTEM AND THE COPPER- SILICON SYSTEM—Robert F. Mehl and Charles S. Barrett.

CEMENTED TUNGSTEN CARBIDE—L. L. Wyman and F. C. Kelley.

TRANSFORMATION OF AUSTENITE AT CONSTANT SUBCRITICAL TEMPERATURES—E. S. Davenport and E. C. Bain.

Wednesday Afternoon

INFLUENCE OF CASTING PRACTICE ON THE PHYSICAL PROPERTIES OF DIE CASTINGS—Charles Pack.

EFFECT OF CERTAIN ALLOYING ELEMENTS ON STRUCTURE AND HARDNESS OF ALUMINUM BRONZE—Selma F. Hermann and Frank T. Sisco.

THERMAL CONDUCTIVITY OF COPPER ALLOYS. Part II. COPPER-TIN ALLOYS. Part III. COPPER-PHOSPHORUS ALLOYS—Cyril Stanley Smith.

APPLICATION OF X-RAYS TO DEVELOPMENT PROBLEMS CONNECTED WITH THE MANUFACTURE OF TELEPHONE APPARATUS—M. Baeyertz.

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PRACTICAL OBSERVATIONS ON THE MANUFACTURE OF BASIC OPEN-HEARTH, HIGH-CARBON KILLED STEEL—W. J. Regan.

DEVELOPMENT OF CASINGS FOR DEEP WELLS — F. W. Bremmer.

MANUFACTURE OF BASIC OPEN-HEARTH STEEL OF FORGING QUALITY—William R. Fleming.

Thursday Afternoon

CONSTITUENTS OF ALUMINUM-IRON-SILICON ALLOYS — William L. Fink and Kent R. Van Horn.

ALUMINUM-SILICON-MAGNESIUM CASTING ALLOYS—R. S. Archer and L. W. Kempf.

EQUILIBRIUM RELATIONS IN ALUMINUM-ANTIMONY ALLOYS OF HIGH PURITY—E. H. Dix, Jr., F. Keller, and L. A. Willey.

EQUILIBRIUM RELATIONS IN ALUMINUM-MAGNESIUM SILICIDE ALLOYS OF HIGH PURITY—E. H. Dix, Jr., F. Keller, and R. W. Graham.

MODULUS OF ELASTICITY OF ALUMINUM ALLOYS—R. L. Templin and D. A. Paul.

QUENCHING OF ALCLAD SHEET IN OIL—H. C. Knerr.

EXPERIMENTS ON RETARDING THE AGE HARDENING OF DURALUMIN—E. H. Dix, Jr., and F. Keller.

Iron & Steel and Machine Shop Practice Divisions, A.S.M.E.

Tuesday Afternoon

PHENOL RESINOID MOLDING TECHNIQUE—CONSIDERATION OF ENGINEERING FACTORS INVOLVED IN THE REPLACEMENT OF METALS BY SYNTHETIC PLASTICS—Leon V. Quigley, Bakelite Company.

PRODUCTION OF PLASTIC TELEPHONE PARTS—A. M. Lynn, Western Electric Company.

Tuesday Evening

FLANGE TYPE MOTOR MOUNTING—Herbert Chase, Associate Editor, "American Machinist."

MECHANICAL DESIGN OF ELECTRIC MOTORS, AS REGARDS STANDARDIZATION AND INTERCHANGEABILITY — J. L. Browne, Westinghouse Electric & Manufacturing Co.

Wednesday Morning

AUTOMATIC POLISHING—Robert T. Kent, Devine Bros.

REPAIR OF WORN PARTS BY ELECTRODEPOSITION OF IRON—T. P. Thomas, Westinghouse Electric & Manufacturing Company.

Wednesday Afteroon

CASE HARDENING WITH AMMONIA GAS—V. O. Homerberg and J. P. Walsted, Mass. Inst. of Technology.

NITRIDING ANALYSES—THEIR PHYSICAL PROPERTIES AND ADAPTABILITY—R. Sergeson and M. M. Clark, Central Alloy Steel Company.

Thursday Morning

REPORT OF ANTI-FRICTION, HEAVY-DUTY BEARING COMMITTEE.

GENERAL DESIGN AND CONSTRUCTION OF HOT SAWS FOR CUTTING HEAVY STRUCTURAL STEEL SECTIONS—A. B. Pearson, Carnegie Steel Company.

Thursday Afternoon

MANUFACTURE OF LARGE WELDLESS FORGED STEEL PRESSURE VESSELS—J. L. Cox, Midvale Company.

MANUFACTURE OF LARGE WELDED PIPE—Leon Cammen, Consulting Engineer.

STRAIGHTENING OF STEEL BY ROLLING—J. Blair Sutton, Sutton Engineering Company.

Friday Morning

APPLICATION OF METALLIC RECUPERATORS TO INDUSTRIAL FURNACES—G. W. Mantle, Surface Combustion Co.

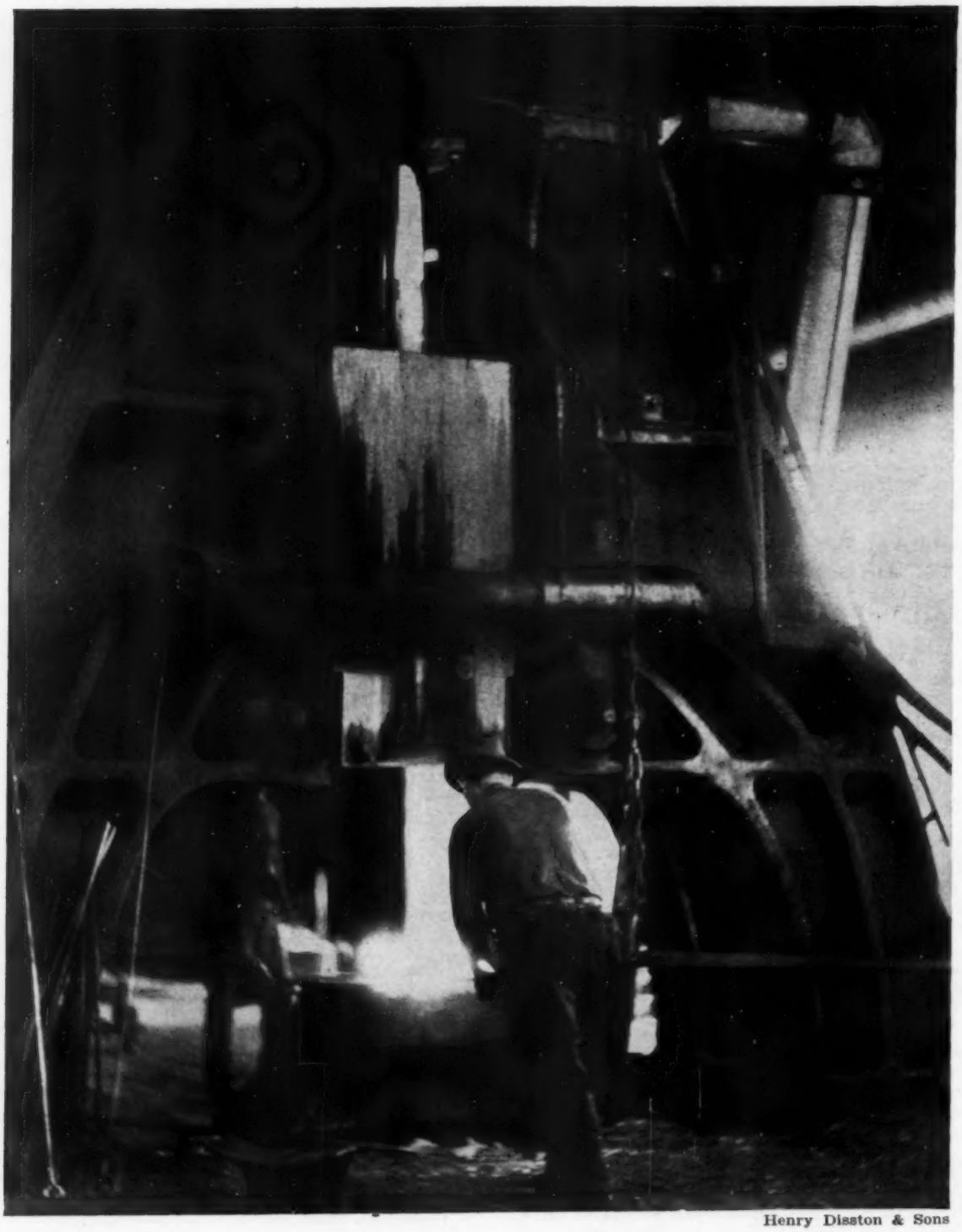
CONTINUOUS REHEATING FURNACES FOR ROLLING MILLS—A. L. Culbertson, Rust Engineering Company.

MANUAL SEMI-AUTOMATIC DEVICES FOR THE PROTECTION AGAINST WIND OF ORE BRIDGES AND SIMILAR STRUCTURES—C. O. Burton, Minnesota Steel Company.

Friday Afternoon

NOTES ON THE PRODUCTION, PURIFICATION, AND USES OF BLAST FURNACE GASES—Wm. A. Haven, McKee Co.

COMBUSTION OF GAS IN BLAST FURNACE STOVES—H. W. Paret, Jr., Swindell-Dressler Company.



Henry Disston & Sons

IN 1840, when John Nasmyth was forced to design the first power hammer to forge a fourteen-inch steamship shaft, he laid down the principles underlying the power hammer of today

WHEN FORGING WAS YOUNG

CHESTER B. LORD
Associate Editor

We have improved the methods, increased the man-output, and reduced the cost, but the quality of the hand hammered forging has probably not been surpassed

IN THE BEGINNING man forged his weapons, tools, and ornaments. It is probable that his first forgings were jewelry for his women folks, because the metal was found in small nodules in its matrix, and could only be manipulated in small homogeneous pieces and hammered into scales or beads. What means he used for piercing the beads is a matter of conjecture, but pierce them he did.

Also in the beginning man used alloys, because the metals he first used were found in that state. Tubal Cain, was described as "a worker in brass and other metals." It would be interesting to know how long afterward the art of forging brass was lost and workers in metal came to the conclusion that it could not be forged. It is fortunate that Tubal could not build a fire hot enough to overheat his metal, or he would have been of the same opinion. On the other hand, he may have worked bronze or copper, and not brass. The same word was sometimes used for all three.

The ancients had one great advantage over the people of this age. They had no precedents from which to reason that a thing was impossible—no time or cost element to complicate production. They had no metallurgical knowledge that we do not possess and hardened copper only by hammering.

After the non-ferrous metals came iron; in its turn it was also used for jewelry. Tiny projections were broken from meteorites and forged into beads. These have been found in the very early Egyptian graves. In most cases much of the iron has oxidized, leaving a filagree work of nickel alloy. In some cases the beads were rolled from strip. The beginning of the iron age has been placed at 1000 B.C., but Egyptian picturegraphs of 6,000 years ago show the Smith family at work with anvil and forge, which indicates that forging of some metal was a familiar art even then. The forge was merely a depression in the ground and the blast was furnished by one or more slaves, or possibly apprentices, each blowing through a reed. As the size of the forge increased the number of blowers increased. In one picture it looks as though one blower were playing a tune on his reed; possibly this was a means of relieving the monotony.

It is probable that the reeds led to a weighted skin reservoir to maintain a constant pressure, and a single tuyère led from this skin to the forge. It is even possible that this arrangement, reversed, was the genesis of the bagpipe. It is difficult to ascribe any other reason for its creation.

An analysis of ancient iron shows two varieties, having the following characteristics:

	A	*B*
Carbon	Trace	0.08
Silicon	0.09	0.02
Phosphorus	0.69	0.35
Manganese	0.00	0.00
Nickel	0.23	0.00

The first of these was meteoric nickel-iron and the other wrought iron. The first was, of course, much the better; it was easier to work and yet made a much stiffer implement, so much so in fact that its use was ultimately confined to making swords. Its superiority was ascribed to the fact that it came direct from heaven, and that such a sword gave its possessor supernatural prowess. Excalibur, the sword of King Arthur is an example. The real reason was the nickel alloy and the comparative freedom from slag. Such swords were comparatively rare, however, for as late as 223 B.C., a Celtic invasion of Italy failed because after one stroke, the swords had to be straightened, and the warriors were thus at a disadvantage. A saga of Iceland, of 1000 A.D. describes a warrior who straightened his sword between every stroke, by drawing it under his foot. On the other hand, Damascus was forging swords that could be bent back double on themselves repeatedly and would spring back straight. The methods used for forging swords at Damascus varied greatly from the practice elsewhere. In the usual method the ore was hand-picked, heated to a red heat, and pounded on an anvil with a piece of iron or copper held in the hand. Several flakes were piled together, and the whole was heated and welded. In this way a miniature bar was gradually built up just as we build up wrought-iron shingles on a porter bar today. When the bar was large enough it was forged into a sword or other implement.

In the several places where Damascus swords were made, they used the same initial methods, but afterward

cut the built-up bar into uniform-sized pieces, flattened them and heated them in tiny enclosed clay pots together with wood and green leaves. These small parts of blister steel were again built up into bars about 8x2x½ in. Each bar was then bent back upon itself and hammered out to its original dimensions fifteen times. After four of these small bars had been made they were piled one upon the other and welded together. This welded bar was drawn out carefuly, bent double, and again forged out, five times. A little figuring will show that a Damascus sword thus contained something like 4,000,000 layers.

What the carbon content of such a sword was I have no idea; the "watermarking" shows alternate layers of steel and iron. The regularity of such marking on some swords indicates that the bar was built up of uniform-sized pieces carefully placed. If the pieces in the crucible absorbed any considerable amount of carbon, they would not be weldable. If they did not absorb carbon, the marking on the finished sword would not be so plain. Their uniformity suggests alternate pieces of iron and steel; only by means of wrought iron could two pieces of blister steel be forged together.

Putting the bagpipe to work

Tradition has it that these swords were tempered by heating them and plunging them into the body of a slave to quench them. Personally I am doubtful that they understood tempering by heat at that time. I believe that most of the hardness was imparted by hammering. A sword hardened by hammering, however, becomes dead; it is hard, but will not spring back when bent. Heating to about 400 or 500 deg. F. restores resiliency. I am of the opinion therefore that the slave, if used as stated, was part of the testing operation. Nowadays they use a mass of soap for that purpose. To support the former contention, however, the opinion is still held in Persia that goat's blood is the best medium for quenching.

Sometime between 300 and 400 A.D. the Pillar of Delhi was forged. This column is 23 ft. 8 in. high and varies from 16½ in. at the base to 12½ in. at its ornamental top. Writers have called it a "metallurgical paradox" and have expressed wonder that a primitive people could forge such a massive shaft without furnace, anvil, or hammers. To me the wonder lies in the conception of the idea: bridging the gap between the small two-pound lump that was about the limit, and a massive 12,000-lb. column, was a mental feat of no mean order.

THE process of forging wrought iron is exactly the same today as it was when the Pillar of Delhi was forged. I have made fifteen-ton forgings from rail spikes and freight car grab handles, together with ¾-in. muck bar to tie the piling together. When we weld heavy unbalanced parts together, we still weld them without removing them from the furnace, just as the ancients must have done with the column. And the "hammer" we use for the welding is a modern adaptation of the only one, I believe, they could have used at Delhi—simply a weight with a long extension on either side that will enable the helpers to stand away from the fire. Such must have been the first drop hammer.

The analysis of the metal in the column shows it to be prime wrought iron, with a Brinell hardness of 188. This column laid on the ground for six centuries and has been exposed to the weather for another millenium, but it shows little evidence of rust. The Association of Wrought Iron Manufacturers are missing a bet in not adopting this pillar as their trademark.

In the Odyssey, Ulysses is made to say, "I saw myself the vast unnumbered store of steel elaborate and refulgent ore, and brass heaped high amidst the regal dome. Immense supplies for years to come." The "steel elaborate," of course, was merely well forged wrought iron, and it is a question whether the "brass" was not bronze. Metallic zinc was unknown to the ancients. The first brass was made by packing copper in calomine and heating it. The zinc penetrated just as it does in the Sherardizing process of today. Or as carbon does in making blister steel.

THE first recorded observation of high temperatures in making iron is by Pliny (A.D. 22-79). "It is a remarkable fact," he wrote, "that when the ore is fused the metal becomes liquefied like water, and afterward acquires a spongy, brittle texture." This may have referred to natural cast iron, or it may have been slag. This same phenomena is observable if wrought-iron shingles are overheated.

It is perhaps worth noting that experiments have been under way for some time to return to the method of making iron direct from the ore by the same low-temperature methods that Pliny observed. It is claimed that the high-temperature melting is responsible for many of the impurities in steel.

Up to the beginning of the 18th century, our knowledge of the properties of metal was very indefinite. In 1640 a Spaniard, named Barba, wrote a complete treatise on metals. Among other interesting things, he said: "Vitriol is the base of all metals. This is proved by the fact that vitriol will dissolve them all." And elsewhere, "The reason why all metals are not gold is because man snatches them from the bowels of the earth before they are ripe." Did he have a glimmering of the fact that some metals change into lead? Even today many people believe that lead may be transmuted into gold—possibly with some reason. By the time of Barba, Spain and Morocco had supplanted Persia as the center of metal working. Toledo had become as famous for its forgings as Damascus had formerly been, and his book represented the best knowledge of that day.

The real beginning of commercial forging dates from about 1840. It was desired to forge a 14-in. shaft for

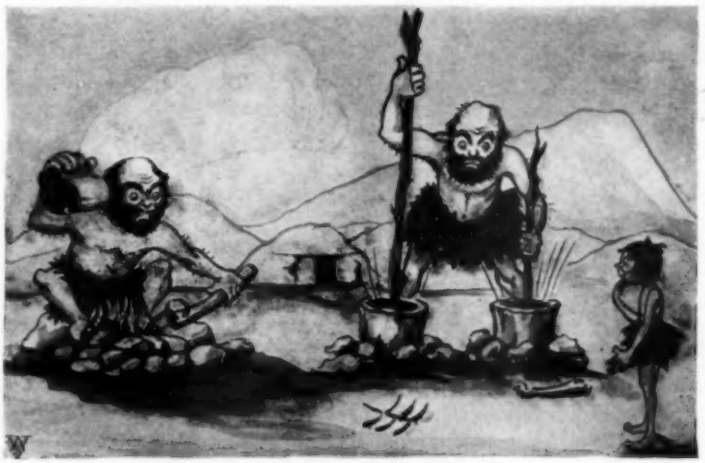
a sister ship to the Great Eastern, and it was declared to be impossible. Finally, an appeal was made to John Nasmyth, and he designed the steam hammer, practically as it is today, but Germany was the first to utilize his design. Contrast the attitude of this time against that of 400 A.D., when the pillar was forged. It is an illustration of the dampening effect on genius, when time and cost elements are introduced. Management was beginning to think in terms of time-cost, instead of in terms of accomplishment only. The ancient possessed no knowledge that we do not, but he had time. For this there is no substitute, where quality is concerned.

A CLOCK MAKER, Huntsman, made the first crucible steel, forging it into clock springs. He followed the practice of Damascus, but used a higher temperature. He introduced sufficient carbon by using blister steel, which already had some, and added charcoal. Had the older forgers thought to repeat their process and heat the same steel twice, they would have produced crucible steel—and cheapened their art, as was done later.

Bessemer, an inventor, developed his process because his cast-iron cannon continually burst. With the Bessemer process began our trouble with alloys, of which even then we were ignorant.

The early meltings on a commercial basis were not successful, because the ore would not react. Mushet suggested that adding spiegeleisen would help. It did, but no one seemed to understand why. Bessemer worked years to show that spiegeleisen was not necessary, but he must have secured some ore that contained manganese and was thus self-scouring. This lack of knowledge of the nature of spiegeleisen, and the effect of manganese, was to bear fruit later in making rails.

As the weight of locomotives increased, and traffic became heavier, there was a demand for higher carbon rails. The effect of increasing the carbon was to make Bessemer rails brittle. Excess phosphorus has the quality of making steel brittle, therefore phosphorus was blamed; and all but one railroad discontinued the use of Bessemer rails.



The mechanization of industry

Eventually, it was noticed that even with higher carbon, the open-hearth rails did not stand up as well as the old Bessemer rails did. It was therefore concluded that something other than phosphorus was to blame, and finally the trouble was found to be due to excess manganese that had unknowingly been added with the spiegeleisen. Inasmuch as the absence of manganese in the open-hearth steel had not helped, it was finally deduced that the desirable rail was an alloy of high manganese and low carbon.

This brought manganese into the limelight, and such alloys became popular. It was commonly thought, however, and still is in many shops, that steel with 1 per cent manganese, or over, could not be drilled or machined. It can be, and is, if the carbon content is low.

The trouble with very learned and very ignorant people is that when they know a thing, they will not admit any new evidence. Pasteur once told the doctors of a famous hospital in Paris that their septic instruments were the cause of 40 per cent of the deaths that occurred among their cases. He told them that if they would pass their instruments through the flame of an alcohol lamp many lives would be spared. Did they do it? No. There was no logical connection between an alcohol flame and peritonitis.

There have always been people like these doctors, "even as you and I," who have said a thing could not be done only to have some one come along and do it. It is for this reason that so many really important discoveries have been made by untrained men.

The separation of nickel from copper is an example. Copper containing nickel was called "Old Nick's copper," hence the name nickel. It was declared impossible to separate the two, and the smelters refused the ore. A shoemaker, not understanding clearly that it could not be done, did it on the kitchen stove. Cobals were little underground imps that played hob with certain ores and metals, but cobalt is a respectable member of the alloy fraternity at the present time.

It is my belief based upon following up many of these "can't be done" jobs, that any metal or alloy that can be melted and cast into a homogeneous body, can be forged, rolled, and extruded under some condition, at some temperature. The malleability of an alloy depends upon the way it was scavenged. Known or unknown impurities that are present prevent the molecules from adhering, and they slide. Brass is an excellent forging metal. I have used it since 1904 for this purpose. I have experimented sporadically with cast iron with indifferent results, but recently I saw bevel gears which, with their teeth, were forged from grey iron. True, the N.S.T.M. says something about cast iron not being malleable at any temperature. Therefore, the forgings I saw were not cast iron, but the man that made them picked up pieces of gray iron around the shop to try out a set of dies. Anyone familiar with them can readily separate gray iron from either white or malleable iron. I recall that tungsten could not be forged until Dr. Coolidge swaged it. I also remember that Stellite could not be recast and retain its cutting qualities, but a salesman did it.

An editorial in a recent issue of a prominent metal-trade paper expressed the opinion that the day of the "garret inventor" was past. It contended that the man who works alone and depends only upon his imagination cannot compete with the scientist who has at his command every imaginable material and appliance and who

benefits from the accumulated knowledge and experience of others.

As a sporting proposition, my money is on reasoning when it comes to developing or discovering a process from a fixed point of departure, such as developing the metals still missing on Mendeleeff's periodic chart; but when it is a case of closing one's eyes and taking a running jump into the unknown, I will bet on imagination every time. Our whole system of aniline colors is based upon the discovery of a man who had the imagination to look for quinine in coal tar.

Laboratory research is merely the elaboration of the crude methods used by the "garret inventor," a "carry-on" when mental fatigue intervenes. It is this same mental fatigue that imagination sidesteps, and that makes so universally true Michelson's statement that no great achievement is the result of pure reasoning, but of desultory thought finally crystallized.

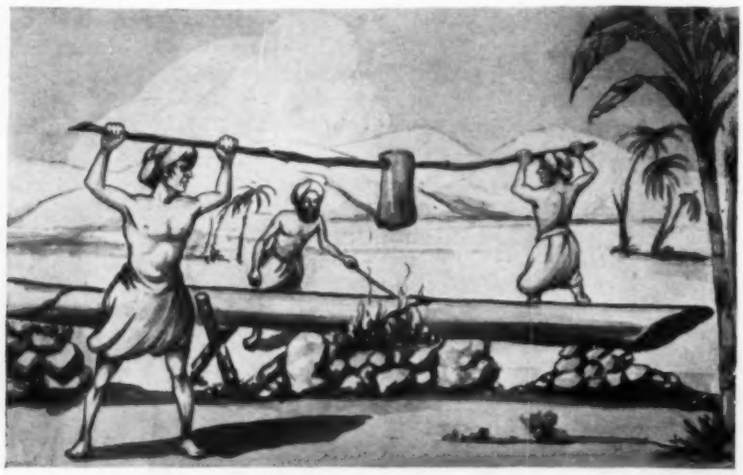
If and when it becomes industrially important to forge Stellite or cast tungsten carbide, a way will be found to do it, and the chances are even as to whether it will be the result of reason or imagination.

Captain Mahan proportioned the progress and influence of a nation to its sea power. That power depended not upon the number of ships but upon the metal those ships carried. Civilization, from the time of Tubal Cain, and even before, has progressed just as fast and just as far as its possession of metals and the knowledge of its metal workers permitted. The iron arrow tip of the savage and the battleship of the British are alike indicative of the progress of civilization in different centuries. How but by the implements and weapons found in excavations have archeologists traced the story of man's progress?

In a home in Philadelphia there is a large picture by a German artist named Schussle. The title of this picture is "King Solomon and the Iron Worker." It shows a scene at an imaginary banquet given by Solomon to his master artisans after the completion of the temple. At the right hand of the king was reserved a seat for him who should be chosen chief among the craftsmen.

To the artisans' surprise a brawny individual already occupied the chair when they arrived. Objection was raised to this, and each craftsman set forth his claim to be called the chief artisan of the temple. The mason, the sculptor, carver, gold worker, and each and every one described the skill required in his particular work and its peculiar importance in the construction of the temple. Solomon turned to the man in the seat of honor and asked him who he was to claim superiority over these others. "I am he who made it possible for the sculptor to form his marble, for the carver to fashion his ivory, and for the gold worker to forge his ornaments. I am the forgesmith. How could they have performed their wonders had I not furnished them tools?" None could gainsay his claims and he remained in the seat of honor.

Incidentally it will be noticed that every artisan thought his business "different" even in those days.



THE FIRST DROP HAMMER

The above drawing is the author's conception of how the four pieces of the wrought-iron Pillar of Delhi were welded, after having been built up separately. No record of the method used has been discovered, and the author is unaware of any other explanation. The curious fact about this pillar is that previous to 300 A.D., no piece of iron weighing more than a few pounds had ever been forged so far as is known

AMERICAN MACHINIST

1930 INVENTORY

of Metal-Working Equipment

Report No. 6—Furnace equipment in industrial plants

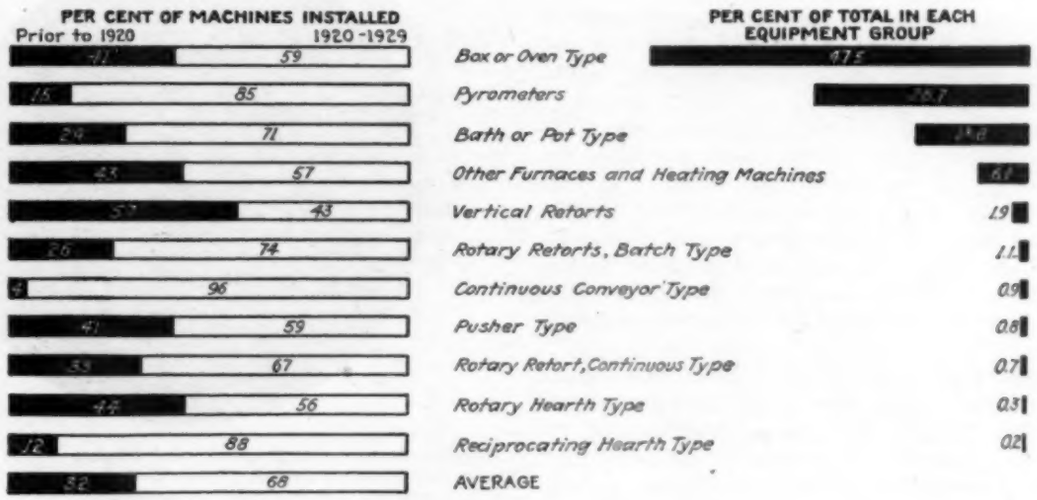
IN 1925, *American Machinist* presented an inventory comprised primarily of machine tools. The current compilation is broader in scope and includes several other classes of plant equipment, such as furnaces, plating, japanning, enameling, lacquering, foundry, and plant service apparatus. Instead of being broken down according to industrial distribution, these added groups will each be reported as a whole.

As far as is known, this is the first country-wide count to be made of these types of equipment. The procedure followed for machine tools in obtaining the percentage over and under ten years of age is retained. Since the previous inventory did not cover these groups, no direct comparison can be made between their status today and that of corresponding divisions five years ago. However, the figures now presented should prove valuable as an index of future progress.

The result of the furnace equipment inventory shows that 32 per cent is over ten years of age. Five years ago the general average for machine tools was 44 per cent. It will be noted that box or oven type furnaces comprise almost half of the entire division, and that these, together with pyrometers and pot type furnaces, constitute 88 per cent. The remaining subdivisions represent special kinds of furnaces each of which forms a small portion of the entire field.

By far the larger percentage of continuous-conveyor and reciprocating-hearth furnaces have been installed within the last decade, reflecting the recent development of these designs. Only 15 per cent of the pyrometers are over ten years old. Improved pyrometric instruments have undoubtedly made the replacement of older types advisable; many furnace installations today are provided with scientific control that formerly depended on the operator's judgment.

While furnaces compare favorably in age with the machine tool groups, they have an advantage in that they are less dependent on replacements for their market than the general run of shop equipment. The widening use of alloys will doubtless continue to add impetus to new furnace installations.



TOOL HARDENING TODAY

A. H. D'ARCAMBAL
Consulting Metallurgist,
Pratt and Whitney Company

Metals and methods employed in the manufacture of small tools and gages

NEW machine tool designs are introduced with such phrases as "more power at the cutting edge," "a minimum of gears and bearings," "direct drive," "larger motors." Since the small tool bears the brunt of these improvements, it must keep pace with the ever-increasing burden placed upon it. Design, material, heat-treatment —these three factors determine the performance of modern small tools. Speculation as to the relative importance of the three is idle, for inferiority in any one of them will vitiate excellence in the others. Since two of the three factors contributing to tool quality are subject to metallurgical control, the maintenance of a well-equipped metallurgical department and a highly trained staff is essential.

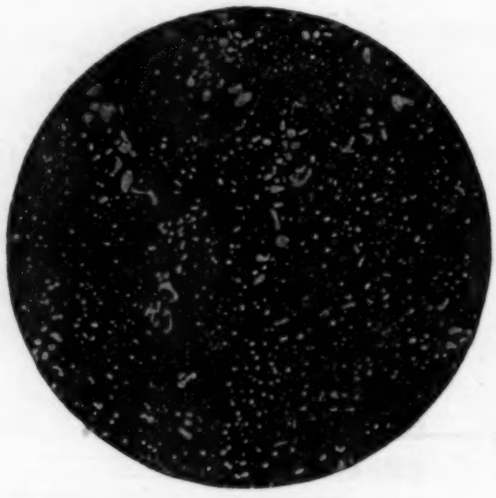
With the history of small tool development has been closely linked the name of the Pratt and Whitney Company, Hartford, Conn. Experience gained in the manufacture of millions of tools enables this concern to fix the proper relation of cutting angle, rake, and relief. Since materials form only a minor percentage of the cost of making small tools, economy dictates the use of none but the best. All steels are bought on specification, and each bar is identified by the heat number stamped upon it. Samples from each heat are chemically and microscopically analyzed, tested for hardness by the Rockwell and Brinell methods, etched in hot acid, hardened and fractured. Irregularities in composition or physical structure are in this way detected.

Ten years ago, practically all carbon tool and high-speed steel produced in this country was melted by the crucible process. It was claimed by the mills at that time that this method of melting produced by far the best quality of steel. It is interesting to note that today well over 90 per cent of the tool steel produced in this country is being made by the electric furnace process, the Heroult type furnace being the one most commonly employed.

It is the experience at Pratt and Whitney that a more uniform and better quality steel is now being produced by the electric furnace than was formerly with the crucible melted process. The analysis is not only much more closely controlled in the electric furnace, but for alloy and high-speed tool steels, the proper temperature is obtained, which is not always true in the crucible furnace. The high frequency induction type furnace is now being used by two or three of the tool steel mills in this country for melting their carbon and high-speed tool steels. It is claimed that steel melted by this process is considerably superior to the steel melted in the Heroult type furnace because of better mixing and greater freedom from impurities. It will be interesting to watch developments along these lines.

During the past ten to twelve years, many special analysis carbon alloy and high-speed steels have been introduced by the mills in this country; the majority of these special types, however, have been fairly short lived as no great improvement was noted in tools made from these special brands. The various types of steels most commonly used today by the small tool manufacturers are as follows:

The fracture of a high-speed steel forging after hardening, showing the velvety structure of the metal



Magnification of a high-speed steel forging 5 in. in diameter etched in nital: carbon 0.70, chromium 4.0, vanadium 1.10, tungsten 18.0. Note the excellent distribution of carbide and tungstides

The fracture of an unforged high-speed steel blank cut from a bar. The segregations and woody fracture denote brittleness

1. Plain carbon tool steel with the following average composition:

Carbon	1.15%
Manganese	0.20
Phosphorus and Sulphur	0.020 max.
Silicon	0.20

2. Carbon-vanadium tool steel. The same analysis as above with the addition of 0.20 per cent vanadium.
3. High manganese, oil-hardening steel. Three different types are commonly used which are as follows:

	A	B	C
Carbon	0.90%	0.90%	0.90%
Manganese	1.25	1.75	1.75
Chromium	0.50	...	...
Tungsten	0.50	...	...
Vanadium	...	...	0.20

Tools made from Type A are usually hardened from a temperature of 1,475 to 1,490 deg. F., being first pre-heated at a temperature of around 1,200 deg. F. Tools made from Type B, after a 1,200-deg. pre-heat, should be heated to 1,420 to 1,430 deg. F. before being oil-quenched. Tools made from Type C are usually heated to a temperature of 1,470 to 1,490 deg. F. after the usual 1,200-deg. pre-heat. As far as our experience shows, all of these types show about the same amount of change during the hardening operation.

4. High-speed steel, 18-1-4 type. The average analysis for this steel, which is by far the most commonly used, runs as follows:

Carbon	0.70%
Chromium	4.
Vanadium	1.
Tungsten	18.

There continues to be a small demand for the following type of high-speed steel, which is especially recommended for all types of turning tools:

Carbon	0.72%
Chromium	4.
Vanadium	2.
Tungsten	14.

This type of steel requires about a 50-deg. lower hardening heat than the first type above mentioned and is also more sensitive to slight changes in the hardening temperature.

5. Cobalt high-speed steel. Two different types are now being used by the trade as follows:

	Type A	Type B
Carbon	0.75%	0.75%
Chromium	4.	4.
Vanadium	1.	1.75
Tungsten	18.	18.
Cobalt	4.5	8.

BOTH of these steels are especially recommended for turning tools of various designs, as well as a few other types of tools that are ground all over after the hardening operation, so as to remove the soft skin always obtained from steels containing cobalt. A temperature of around 2,400 deg. F. is required to harden these cobalt steels; they show characteristically a marked "sweat" in the high-speed steel chamber before the tool reaches the furnace temperature. For this reason, it is the tendency of the furnace operator to pull these cobalt steel tools before they reach the proper heat, resulting in a shorter life than would be obtained if the tools remained the proper time in the high-speed chamber.

Magnification of a 5½-in. high-speed steel bar etched in nital: carbon 0.71, chromium 4.0, vanadium 0.97, tungsten 18.04. The carbide segregation in the form of residual cast structure contrasts with the smooth grain of the forged blank

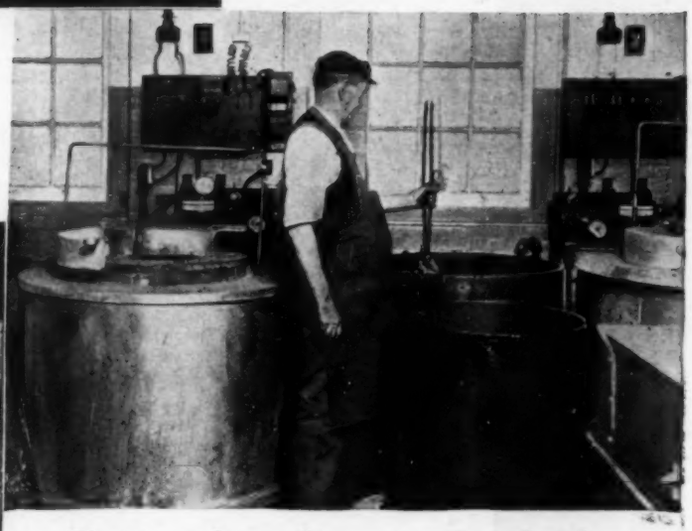
A remarkable improvement in physical characteristics and performance is obtained through the proper upsetting of high-speed steel. The accompanying illustrations indicate the superiority of the high-speed forged blank as compared with one cut from the bar. The increased grain refinement produced by forging may be noted in the fractured bars and in the microphotographs. All Pratt and Whitney high-speed steel cutters of the larger diameters are made from forged blanks, which adds considerably to their life between grinds.

In processing work through the hardening room, the first step is to make out a hardening record card for each order and send it to the metallurgical department for the proper specifications as to material and heat-treatment. Temperature, time, kind of quench, drawing time and temperature are given for the particular tool to be made. These data are based on years of toolmaking experience. The cards are filed away after each batch is hardened, forming a permanent record of tool treatment.

Carbon tools are heated in electric lead pots at 1,440 to 1,500 deg. F. quenched in brine, and drawn in oil or oven furnaces. Only lead of the best quality is used, as an inferior product will stick to grooves or threads; the time taken to remove the lead makes the use of a

Dies are strung on wires for convenience in heating and quenching

The important element of time is controlled by clocks which automatically operate signal lamps



Electric and gas furnaces are employed to harden high-speed steel; the gas furnaces have preheating chambers

Small taps are ganged in special tongs by means of spacing blocks

The file maintains its place beside a modern testing machine for determining hardness

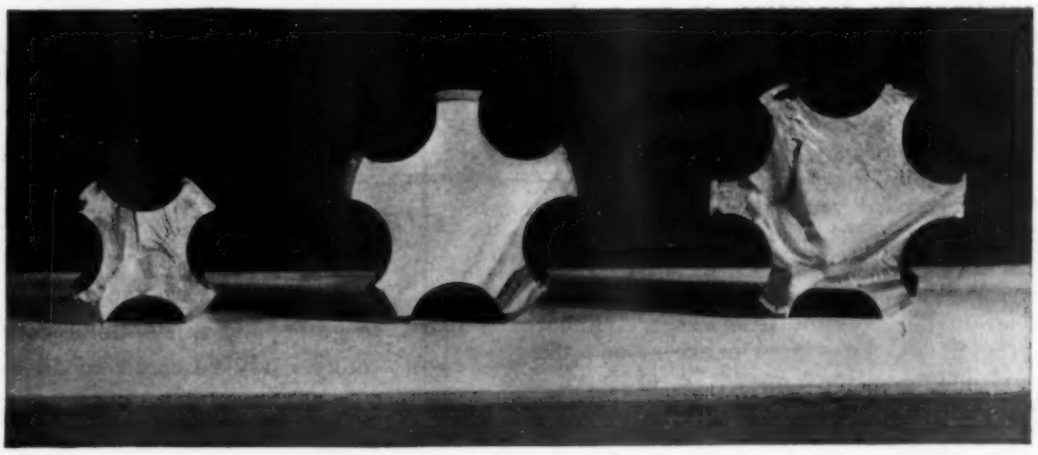
cheaper grade more expensive. The molten lead is kept well covered with charcoal to prevent oxidation. Carbon steel taps, usually required two operations—one to harden the thread and the other to toughen the shank. Small taps are held in gangs by special tongs for convenient handling during heat-treatment. They are first arranged in the grooves of a block, which spaces them equally, so all may be picked up at one time. The tongs are provided with hooks from which they are suspended over the lead pots on horizontal cross bars when the taps are being heated. These bars are mounted on springs in such a way that the weight of the tongs forms an electrical contact which operates a signaling device. When the taps have been immersed the proper time, an electric lamp is automatically lighted indicating that they are ready for quenching. The lead pots and other heating units are provided with automatic temperature control. The brine used for quenching is maintained at 65 deg. F. by a circulating cooling system located in the basement. The oil tempering tanks are also electrically heated and automatically controlled. Two soda solution tanks are used for cleaning. The shanks of bent taps used in automatic tapping machines are heated in lead pots. They are then bent is special mechanically-operated fixtures, the temperature employed producing the correct spring temper in the shank. Shanks that are too hard are likely to break, while those with too low a Rockwell hardness will not retain the correct shape.

For high-speed steel tools, furnaces are used both of the gas-fired and electric Globar types. The difficulties of securing sufficiently high heats for high-speed steel have now been overcome, and a temperature of 2,350 deg. F. is commonly used. Even at this high heat, a limit of ten degrees can be maintained. The gas-fired furnaces have pre-heating chambers above the high temperature chambers which make for fuel economy. All furnaces are controlled by pyrometers and have signal lights that indicate whether or not the furnace is within the proper temperature range. A white light shows that the heat is within the prescribed tolerance; red is a warning that the heat is too low, while green shows that it is too high.

The larger electric, high-speed furnaces have heating chambers 20x34 in. and are of a 70-kw. capacity. Two of these furnaces are in use together with seven of the standard box type. All high-speed tools are given a high drawing treatment after quenching at from 1,000 to 1,200 deg. F. dependent on the type of tool. This treatment improves the tool toughness without sacrificing hardness. Certain kinds of high-speed tools are straightened after quenching before reaching room temperature, as high-speed steel does not finally harden until it falls considerably below 800 deg. F. Other tools are straightened by reheating with a blow torch. This operation requires a high degree of skill as too little heat may result in tool breakage while too much may produce softness. Electric butt-welding machines are employed to weld the shanks to the cutting ends of certain tools. When tools are ready to leave the hardening room they are tested by the Rockwell hardness tester and by means of special files. Standard steel blocks are used to check these files from time to time so they may be discarded when worn.

In addition to small tools, Pratt and Whitney makes gages of all types, including gage blocks of the Hoke and Swedish type. Gage blocks involve a problem of permanence in size as well as hardness. The metallurgical department has met these conditions with special steel which is quenched to produce extreme hardness. After rough grinding, the blocks are given a seasoning treatment which produces marked stability. On a test conducted with 4-in. blocks possessing this hardness, they showed only five millionths of an inch variation over the entire length after a year's observation.

Perhaps one of the secrets of Pratt and Whitney's success in toolmaking is that its work is not regarded as finished when shipment is made. The performance of the tools in the customer's service is closely watched, and the experience thus attained has made for a progressive policy in the quest for improved manufacturing methods.



When properly hardened, fracture sections of high-speed steel taps show a fineness of grain which reflects sound metallurgy

EXECUTIVE FORUM

Research or Retrenchment?

DONALD M. GRAHAM, president of the Viking Tool Company, scrutinized the requisition placed upon his desk for approval. He was about to consign it to his "waiting" file when Alfred Hendricks, his chief metallurgist, entered.

"Good morning, Mr. Graham," greeted Hendricks. "I want to talk to you about a requisition I sent through for metallurgical equipment."

"Yes, I have it here," said Graham without enthusiasm. "You are asking the company to spend a good many thousands of dollars for non-productive apparatus. Don't you think this a poor time to present a proposition of this kind?"

"I think it too important to wait," answered Hendricks. "I prepared the list with an eye to economy, but there is no substitute for the best in scientific equipment. The requisition includes a metalloscope, new balances, a muffle furnace, hardness testers, pyrometric instruments, and a number of other items we need badly to conduct our work properly."

"But why the sudden desire to spend a lot of money," asked Graham. "We've been able to sell tools and haven't received many complaints."

"It's not exactly sudden," said Hendricks. "I've mentioned before that we were in need of new laboratory equipment. The fact is we're very inadequately equipped considering the dependence of our product upon metallurgy. Steel treatment and composition is a rapidly moving subject, and we must keep up with the procession."

"But you have facilities to do that," said Graham. "We get several technical magazines on the subject, and the company has enrolled you in societies which are presumably up-to-date. What more is needed?"

"Both the societies and magazines are mediums for the interchange of ideas," said Hendricks. "Without individual progress by the society members and the magazine contributors, neither would be of service. I've done what I can to keep in touch with recent developments and have found the practice helpful. But we must go further. This company is large enough to do some research on its own account—to make a definite contribution to the advancement of metallurgy."

"I'm afraid you're getting a little too idealistic, Hendricks," said Graham. "Its pleasant to think of showing the way in science, but not always feasible. After all, we're in business for profit, and at present the surplus isn't large enough to go in for philanthropic research activities, even though the wisdom of such a course were more obvious."

"I believe this business of research is an intensely practical one," said Hendricks. "If we don't do our share we'll soon fall behind—in profits as well as in scientific knowledge. It has been demonstrated time and again that scientific progress has a direct influence upon commercial success. The equipment I've recommended cannot be considered as non-productive. It will pay real dividends."

"If the situation is as serious as you say," asked Graham, "how is it we haven't suffered from the lack of this equipment before? We're still selling tools, and our customers come back for more."

"I think we've held many of our customers because of the company's reputation. There is a certain inertia in business which will carry a manufacturer along even when his initiative has slackened. But now is the time to lay pipe for the future. If we don't, we'll certainly feel the effects of our apathy sooner or later."

■

What Do You Think About This Problem?

How far should a company go into original research activities? Should it attempt merely to keep in touch with current scientific developments, or should it strive to go beyond this? Some concerns today carry research to an extent that their activities seem remote to practical commercial applications. What research policy do you consider sound? Should scientific progress be dependent on individual effort or should means for greater co-operation be developed?

. . . Discussion

of Executive Problems

Can Ideas Be Allocated?

Efforts of the average engineering staff are spent in rendering direct service, and the time so spent should be charged directly to the thing served. Attempts to apportion this expense as a part of overhead have not been satisfactory, as the jobs served do not bear their correct portion of expense, while others not served are overcharged, which tends to overprice in one instance and underprice in the other. In our experience, we have followed a method where each effort is charged to the thing served, believing it is incorrect to attempt to cover engineering expense by using a flat overhead, and thereby charging costs of development of a new product or that of estimating to the cost of a current production job.

Our plan is, issuance of a charge number for every job started. In addition, a charge number is issued for each inquiry received, which charge is used to accumulate estimating and related designing costs, as well as an identification for the sales department. Costs of development are carried as a deferred expense, until such time as the product is manufactured when it is charged to the cost of manufacturing, either in part or entirely, depending upon the amount involved and the possibility of repeats. If the product does not go beyond the development stage, the developing costs are charged to profit and loss.

To accomplish this, it is necessary that the engineering staff record their time in a manner similar to that of other productive workers. The opposition we met has been confined to new employees on the engineering staff, who had not been sold to the necessity of definitely allocating costs, and were unaccustomed to having a record kept of the time they consumed. No real reason is apparent why this type of effort should be considered differently from that of a mechanic, as the labor spent is of a similar direct nature.

—PAUL S. HECKMAN, *Cost Accountant, American Die & Tool Company.*

Should Small Shops Co-operate?

As manager of a small shop, it seems incredible that anyone could answer this question in the negative. But the greatest advantage of co-operation is in the use of machines and tools rather than in bookkeeping or other office work. To equip a small shop with all the machines and tools necessary for occasional use is a large and entirely unnecessary expense if there are other shops with whom it is possible to co-operate.

For example, we have no electric portable drill, and our nearest neighbor has no portable snagging grinder. Why should each of us go to the expense of duplicating this equipment, when we do not use either more than once or twice a month? It is the same with small tools. The cost of a complete set of reamers is too much to pay when it is possible for each shop to buy only those needed most frequently. In our experience, the occasional size for which we do not buy a reamer is usually a standard size with our next neighbor. Of course the borrowing must be mutual. It would not do for one small shop to get his tools at the expense of the other, but in my experience both make a substantial saving.

With regard to bookkeeping, it seems to me more satisfactory for each shop to hire the bookkeeper for part time, rather than to try to hire one on a co-operative basis. There are bookkeepers who can be hired for any length of time from an hour a week to half time. Some work for a number of businesses. Others are former bookkeepers who after marriage do not desire to work long hours. Some of them can be hired at quite reasonable prices.

—A. W. FORBES, *Forbes & Meyers.*

Can Engineers Sell?

Some of the most successful salesmen in the machine tool industry today are men who served their time in engineering officers. The days of the back-slapping, story-telling salesman is over, a thing for which we all can be thankful. When buying machinery, I would rather talk to a man who can give me the facts and technical information offhand, rather than wait for them to be looked up, or for a letter of explanation to arrive.

A salesman I know quite well, called on me to see if I could help to get our engineers interested in the product that he is now handling; I asked him a few questions about it, and he kept consulting his book saying he would have his engineer forward me a letter with the information wanted. Eventually this information arrived, and it was in a form that I could present to our engineers with the net result that there will be something in it for the salesman. Had I been a stranger to him, I am afraid that there would have been no trials. It is all very well for a salesman to understand phychology, to have personality, and to be a good fellow, but give me the man who knows his stuff every time.

—CHARLES R. WHITEHOUSE, *Standards Engineer, The Holtzer-Cabot Electric Company.*

Inspection or Discretion?

An inspector is placed on the job to determine whether the parts can be used; a checker merely determines how close the parts are to specifications. The checker is bound by very rigid restrictions and can make no decision, the part is either right or wrong. The very nature of real inspection denotes judgment and discretion. The fact that a part has slight discrepancies may not mean that it will not function as well as a part which is exactly right. Checking for size would throw out such a part but inspection will pass it as usable. The working limits on drawings are necessarily closer than the real limits of acceptable work. They set up a mark for the men to work to, but some leeway must be allowed if the scrap heap is to be kept at a minimum. Hence the inspector is expected to use judgment in his work.

—L. O. BROWN, *Toolroom Foreman, Holcomb and Hoke Manufacturing Company.*

Henry Disston & Sons

WHITE as light of noonday sun, roll lengths of gleaming metal to meet the needs and whims of mechanized mankind

CURRENT VOGUES IN METALS

HERBERT CHASE
Associate Editor

NO MATTER how much or how little the modern metal-working shop may welcome or rebel against change, there can be no doubt that it must expect to deal with a much wider variety of materials in the future than it has in the past. Metals and alloys of nearly all descriptions are undergoing rapid change and improvement. More and more must such shops rely upon the engineer and the metallurgist if they are to keep abreast of the times.

At present there is a marked trend toward the use of non-corrosive alloys, both in ferrous and non-ferrous fields. Alloys of many kinds are being chosen to give longer life, to improve appearance, to increase strength or decrease weight, to resist abrasion, or to provide one of a score of other properties necessary to meet market and service conditions. And nearly every new material used presents some new problem in the shop.

During recent months the so-called "stainless" or corrosion-resistant steels have become an outstanding subject of interest to metal-working shops in nearly every field. Their use no longer is confined to cutlery and to cooking utensils, but is extending rapidly into shops that manufacture for the building equipment, trim, and hardware trade, as well as into automotive plants and into shops producing apparatus for the chemical, mining, oil, and numerous other industries.

Scores of steels, differing widely in composition and physical qualities, are now included in the group. All such steels are presumed to resist atmospheric corrosion indefinitely, and many of them also resist, to a marked degree, the action of certain acids and other chemicals, even at elevated temperatures. All of them contain a high percentage of chromium, and many have also about half as much nickel as chromium. A considerable group, but not all, are made under the Krupp Nirosta patents, and several of these are designated "KA-2," standing for Krupp Austenitic, No. 2; but there are several grades of this alloy for different purposes. They usually contain 17 to 20 per cent chromium and 7 to 10 per cent nickel. Another group, often termed rustless iron because of very low carbon content, is made from a chromium ore by a very different process and has little if any nickel content. Its chromium content usually runs from 12 to 14 per cent, it being reported to have less corrosion resistance and less favorable drawing qualities than certain of the more expensive chromium-nickel alloys.

High-chromium steels are available today in sheets, strips, bars, tubes, shapes, and wires. They can be rolled, drawn, pierced, spun, swaged, forged, welded, soldered, brazed, sheared, bent, ground, polished, and worked by other means, and also can be drilled and machined in other ways. They are made up into castings, both for decorative and industrial purposes.

KA-2 alloys work-harden rapidly. This naturally affects machining rates. Some makers advocate moderately heavy cuts at low speeds and others light cuts at speeds of 30 to 50 ft. per min. Drilling at a peripheral speed of 10 to 12 ft. per min. maximum, and with a maximum feed of about $\frac{1}{4}$ in. per min. on a $\frac{3}{8}$-in. drill, is recommended. A mixture of water and turpentine is a good cutting lubricant, flour or sulphur sometimes being added with advantage. Lard oil containing one pound of sulphur per gallon also is used. Tools should be kept sharp, should have a steep lip and a side rake not less than 15 deg. for best results.

Alloys of the KA-2 group are worked to best advantage in an annealed condition, the annealing being effected by heating rapidly to temperatures of 2,050 to 2,150 deg. F. and then cooling rapidly, by quenching, or in an air blast in the case of thin sections. Many steels would be hardened by this treatment, but the reverse is true in these. Annealing between drawing or other working operations is accomplished by similar heat-treatment. A pickling operation to remove scale is required after heat-treatment. The scale is highly abrasive and will ruin drawing dies unless removed.

Although some of the high-chromium steels have excellent drawing qualities, heavier pressures are required to deform them than are needed for deep-drawing carbon steel. The blank must be subjected to proper tensioning by the pressure ring. Sometimes a double bead is employed in the ring and die. A special lubricant, usually one that is water-soluble, is required, and more than the customary clearance between the die and punch is necessary to prevent buckling or wrinkling. Dies must be extremely smooth, as imperfections tend to accelerate scoring. For this reason some dies are finished with a stone in preference to an emery wheel. In general, deep drawing requires one or more annealings, each of which must be followed by a special pickle to remove scale, hence, there is no point in using polished sheets for such work. Pickle finish sheets also

Examples of parts and fittings made from Krupp Nirosta Steel

are said to handle more easily in the dies and do not show the "orange peel" surface often resulting when ground sheets are deeply drawn.

Grinding and polishing have proved to be much more difficult with these steels than with ordinary steels, but are done successfully by many users. Successive grinding with Nos. 80, 120, 150, 180, and 200 abrasives, usually on a soft wheel with a stearic-base high-melting-point grease, is required on hot-rolled pickled sheets. On cold-rolled sheets the No. 80 abrasive often can be omitted. Wheel speeds of about 6,500 to 8,500 ft. per min., are recommended. Some steel companies now furnish ready-polished sheets, especially for use where no annealing is required. Chrome oxide is reported to give the best color in the final buff.

Certain alloys in the high-chromium group are made relatively free-machining by phosphorus or sulphur additions during manufacture. Recently zirconium, sometimes added as zirconium-sulphide, has been employed to advantage for this purpose. Its use tends to eliminate hard, brittle inclusions and to give a better grain structure. One of the free-machining corrosion-resisting steels, termed Bethalon, can be smooth-turned at 200 surface ft. per min. and threaded at 150 to 175 ft. This alloy does not air-harden materially.

Recent research is reported to have proved the feasibility of substituting manganese for nickel in the production of high-chromium steels having stainless and physical qualities equal to those steels in which nickel is an important ingredient, but such steels are not yet generally available.

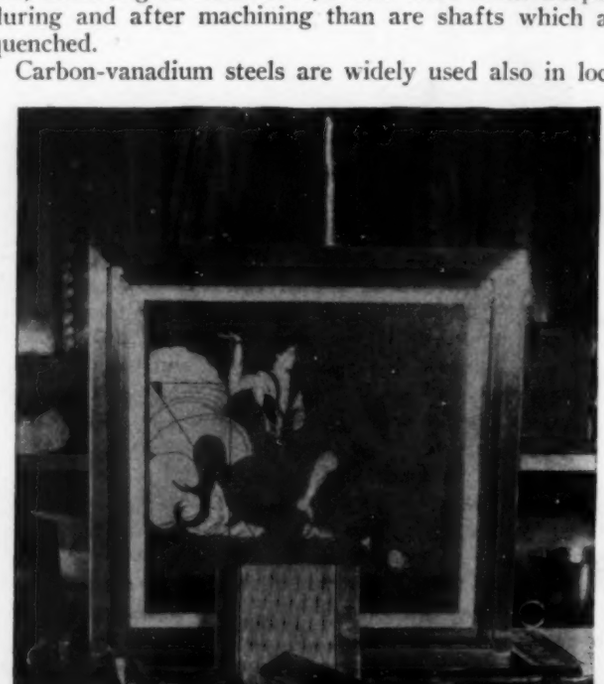
NICKEL and chromium still hold a strategic position in the alloy ferrous casting field, especially where wear resistance is of importance. Automotive cylinder castings afford one large outlet in this category. Another and very important one, from a production standpoint, is the substitution of castings in this class for stamping and other dies in which tool steel usually has been relied upon heretofore. The Ford Motor Company is said to have displaced a large proportion of its tool-steel dies with castings having the following composition and thereby to have increased the life of dies from five to twenty times:

Carbon, 3.20 to 3.30 per cent; manganese, 0.4 to 0.5 per cent; chromium, 0.6 to 0.7 per cent; nickel, 2.0 to 2.5 per cent; and silicon, 1.10 to 1.30 per cent. As cast, this alloy has a Brinell hardness of 248. After rough machining, it is heated to 1,550 deg. F., quenched in oil, reheated to 900 deg. F. and cooled in air, after which it has a Brinell hardness of 286 to 321. This treatment doubles the life of dies, as compared to their use without heat-treatment.

Similar alloys are being used, at least experimentally, for brake drums where wear resistance is an important factor. Iron casting alloys containing about 14 per cent nickel, 6 per cent copper, and 2 per cent chromium are being developed for applications in which freedom from grain growth and non-magnetic qualities are desired. There is also an increasing demand for many different alloy steel and iron castings in which properties comparable to forgings are obtainable or in which unusual resistance to corrosion is a determining factor. The development of tungsten-carbide tools with which some very hard or tough alloys, otherwise almost unmachinable, can be machined has helped to increase the demand for such castings.

Partly because of the simplification in heat-treatment and other production operations, carbon-vanadium steels have seen wider use in recent years, as, for example, in long automobile crankshafts. After forging, these shafts are re-struck and die-straightened at the normalizing temperature. When air cooled the shafts are ready for machining without further heat-treatment, and, being free from the unequal strains often set up by quenching, are, according to some tests, much freer from warpage during and after machining than are shafts which are quenched.

Carbon-vanadium steels are widely used also in loco-



A group of stainless steel products. A variety of rolled shapes is available. Much of this metal is used for architectural and decorative purposes

motive forgings such as axles and side rods, partly because of their high strength and other good physical properties, but also to simplify heat-treatment and to preclude injury when reheated for straightening when bent in service. Vanadium steels generally tend to minimize grain growth and the consequent increase in brittleness, when heated.

Manufacturers of locomotives, as well as of Pullman and electric cars for passenger service, are employing more chrom-vanadium springs to improve riding qualities, avoid settling, increase life, and reduce the weight of their products. A saving of 400 lb. per car is realized in some cases.

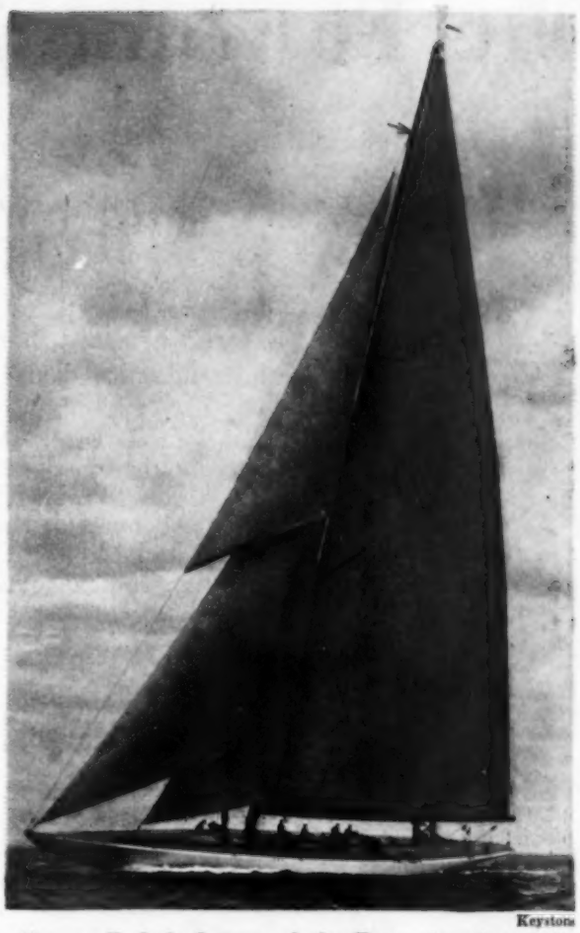
Chrome-vanadium steels of the S.A.E. 6120 to 6135 group are used to advantage in welded construction, especially in aircraft tubing, partly because the heating and deposition of vanadium steel at the weld produces relatively little change in grain structure in and adjacent to the weld, where adequate strength is maintained without subsequent heat-treatment. The same steels also are seeing extensive application for forged high-pressure and high-temperature containers needed in cracking petroleum and in making synthetic ammonia.

Another group of steels gaining wider use includes those intended for nitriding, a form of surface hardening which, in some respects, is much superior to ordinary case-hardening. Nitrided surfaces are extremely hard and resist corrosion to a marked degree, but require very special equipment for their production. They are obtainable only in aluminum-bearing steels of a particular analysis. One advantage of the process is that the temperature at which treatment is effected is comparatively low.

Among the non-ferrous alloys, those in the aluminum group have come more and more into prominence, the most important factors in their favor being light weight, relative freedom from atmospheric corrosion, and a color that is much in favor for many decorative purposes. For certain applications, aluminum alloys having physical properties approximating those of steel have gained wide acceptance.

IN the architectural field aluminum has made extremely rapid advances, both in cast and wrought form. Freedom from corrosion; favorable color, readily altered by chemical treatment; ease of fabrication; and lightweight all have helped in this direction. A large variety of extruded shapes now are obtainable, and castings can be made, of course, in almost any intricate or decorative design. To some extent aluminum shapes are displacing bronze for window frames and outside trim, and many hardware items are being made in aluminum where brass, bronze, or nickel-plated metals were used almost exclusively heretofore.

Weight reduction in machines of many kinds, as well as in automotive vehicles, railroad rolling stock, and traveling cranes accounts for an ever increasing use of aluminum alloys. In some cases the saving in weight alone justifies the higher price per pound of the parts, but in others there is also a worth-while saving in machinability. In railway work, weight saving is said to net from five to ten cents per pound per year reduction in operating expense, hence a considerable advance in first cost is justified where corresponding weight reduction is realized. Much the same situation has resulted in increased use of aluminum in bus and truck bodies and chassis parts, and probably would do likewise in passenger cars if the average purchaser could be brought to realize how important a factor in operating cost weight saving may become.



Keystone

Almost all deck fixtures of the Enterprise, America's Cup Defender, are 18-chrome corrosion-resistant steel made by the Lebanon (Pa.) Steel Foundry. Its 168-ft. mast is of Duralumin, and its 127-ft. hull is of Tobin Bronze fastened to steel ribs with Tobin Bronze rivets

Among the aluminum-silicon alloys recently developed is one called Lo-Ex especially suited for making pistons. It expands much less under heat than most aluminum alloys, hence less clearance is required, yet its heat conductivity is high and its resistance to wear is also good. It is so hard, however, that tungsten-carbide or diamond tools are required to machine it.

Extended use of other non-ferrous alloys, especially those bearing copper, has resulted mostly from special considerations such as corrosion resistance, decorative effect, ease of fabrication, superior wear resistance, or some other superior physical or chemical property. The copper-silicon-manganese alloy called Everdur is a good example. This metal, because of freedom from season-cracking and corrosion, a strength equal to mild steel, and adaptation to welding and forging, has proved very useful in the form of bolts, rivets, sheets, and other forms. It is used for water tanks, both welded and riveted, numerous electrical fittings, outside building hardware, water heaters, condenser tubes, non-corrosive castings, and for many other purposes. It is easier than steel to machine, resists many acids and salts, and some caustic solutions, and is available in several wrought forms, including rods, sheets, tubes, and shafting, as well as in ingots for casting.

The Foreman's Round Table

WHO'S WHO IN INDUSTRY

"HELLO Old Scout," hailed Al, as he met Ed early Monday morning. "How did you enjoy your vacation? I missed you."

"Fine, Al. Part of the time I followed my own instincts, fished and bummed around, and part of the time I followed my wife's instincts and lived in a swell hotel at the seaside. I stood it as long as I could, then Joe Black and I ditched the women folks and visited some big plants."

"I see, like a letter carrier climbing mountains for recreation."

"Well anyway, the plants we visited were so different from this dump that it was a complete change."

"Did you see anything interesting, or learn anything new?"

"Yep, both. We visited one plant where they had a wonderful drop forge department. They used mostly crank presses instead of drop hammers. In the same building they had a heavy forge shop and a blacksmith shop to take care of small quantities and special forgings. One of the assistant superintendents showed us around, and he told a story about this drop forge department. I don't believe it, but it was a good joke the way he told it. It seems that some 'nut' had a new idea about setting rates. As I got it he based a man's rate not on what kind of work he did, but on his value to the industry as a whole. Then he added something extra if the job was disagreeable, dangerous, or if the wear and tear on clothes and shoes was excessive. The whole idea sounded a little crazy."

"It still does, Ed, but I think I see a glimmer of reason."

"Under this scheme of classification, as they call it, several old and decrepit blacksmiths got about 20 per cent more pay than the young fellows in the drop forge department. It must have been that they didn't have any age limit in the blacksmith shop. This assistant superintendent went on to tell us that a committee called on the manager to find out why a forger who turned out more and better work than a blacksmith should receive less wages. The manager listened to their spiel and told them that the difference between a blacksmith and a drop forger was that the blacksmith furnished his own brains, while the designer and toolmaker furnished the brains for the drop forger. Maybe the manager did not put it as bluntly as that, but that is the way it was told us. Anyway it was a good bluff, and the drop forgers are still trying to think of an answer."

"I have read about that method, Ed, and I think it is the only fair way of setting rates. Why should a wood butcher get as much as a pattern maker, or a machine operator as much as a toolmaker? As far as the brain part goes, the manager was only quoting the law of transfer of skill, which says, 'The skill required to operate a machine is inversely as the skill transferred into its mechanism.' All the drop forger had to do was to use the material as furnished him, heat it, place it in a die that was furnished him, and trip the lever on a machine that was also furnished him. The blacksmith had to use judgment with every blow of the hammer; he transferred his own skill into the forging. Any system or any machine is merely stored up skill."

"Well, I thought it would be dangerous to tell you about it, but I know one thing—I am going to treat blacksmiths and automatic screw machines with more respect. When I go through the automatic department hereafter I am going to take off my hat and walk very, very softly."

Al believes that men can be classified as the equivalents of expert, mechanic, specialist, operator, and helper, regardless of their occupation. He does not believe that single action trades, like pipe fitting and brick laying, are on a par with the carpenter's and machinist's trade. What do you think?

▸ ▸ ▸ Discussion of Former Topics

Do Errors Cancel Each Other?

Since we all are dwelling in our own glass house, let's be careful about throwing stones. Just think what a sorry mess we would all be in if everybody from the president down had to make good all mistakes.

Erring is as elemental a force as, for instance, the expansive force of heat. You cannot stop either one, but as both are costly and destructive if uncontrolled, we provide against them.

Whoever invented the eraser on the end of a pencil, was a judge of human nature. An executive should use similar judgment in the administration of his business, and provide the necessary protection against errors, in the form of supervision and inspection. If that provided protection fails now and then, the resulting losses must be charged to operating expense the same as any other loss.

Of course all this does not mean that the man who makes errors should be commended. Each particular error of omission or commission should be dealt with effectively and wisely, which does not necessarily mean harshly.

It may be said, in justice to erring humanity, that an error is never made intentionally; if it were, it would not be an error. —Karl Merting, *Tool Foreman, C. B. & Q. R.R., Lincoln, Nebraska.*

The Safety Court

The greatest trouble to the average machine shop foreman regarding accidents is the lack of what may be termed "accident sense" among certain workers. They appear in all shops, and no matter what schemes may be introduced, they are hard to cope with.

The suggestion here of a safety court, appears to the writer as something new in dealing with such men, if only by getting rid of them. The good workman recognizes that these men are a positive danger to have about, and providing such a court is conducted on impartial lines, it is doubtful if any ill-feeling will arise, except among the culprits themselves.

Once rid of them, accidents would be reduced to a minimum, and a good deal of present-day propaganda, with the expense attached, would be unnecessary. This suggestion of a safety court is, in the opinion of the writer, well worth a trial. It is the avoidable accidents that are the present-day foreman's main source of worry and loss. —F. P. Terry, *Belfast, Ireland.*

High Rates

I see no reason to think pacifism actuates foremen, for in thirty years I have known only one who adopted the attitude "peace at any price." Though lovable and skillful, he did not control the rougher element in the shop. There is, however, a great tendency of late years to avoid friction where possible, and maintain happy relations with men. This is laudable. I have yet to meet the foreman who is lavish in money matters, or who is frightened into giving advances. On the other hand, instances occur where they withhold an advance, but offer it when the man has secured another job. Better have kept the man settled.

Weakness that tends towards altruism is more noticeable in the attitude of those in higher positions. They sometimes have control, but lack intimate contact witn men. Their weakness is not in paying high wages, but in administration and in dealing with complaints. Reports of insubordination, defiance, abuse, or inefficiency are not handled with sufficient sternness. I have known patience, tact, and psychology advocated in such cases, and the culprit has got off scot-free. Doubtless all this is prompted by the spirit of altruism, but severity must have its proper place. Though appreciating clemency, one would rather a chief were characteristically stern than too lenient with wrong-doers whose conduct demoralizes the shop. —Wm. Bryce, *Sheffield, England.*

Government Work

I do not think many shops make a charge of any kind for government work: it is not considered worth while. Rather they close their eyes to it and pretend to believe it doesn't exist, as long as it doesn't get too noticeable.

The average foreman winks at it until it is carried too far and interferes with the regular work.

The usual "foreigner" (to give "government work" its common name here) generally consists of repairs to household "gods" of various kinds which have a sentimental value in their owner's eyes.

These little jobs occur infrequently and I don't think there is much lost by letting them go through, provided they don't come too often. The idea of making a charge hardly seems worth while.

—T. B. Greening, *Coventry, England.*

Experience or Authority?

Every shop has, and is fortunate in having, old hands who are individually expert in certain phases of shop work. It is up to the foreman to see that this skill and experience is used wisely and without friction.

If Ed had personally given Hacker every job assigned to him, he would have avoided dissension and would soon have realized what kind of a workman Hacker was.

On a machine such as a lathe, shaper, or drill press, where it does not take long to grind tools, time can be saved if the operator grinds his own drill or tool-bit. Tools that require considerable time should be ground by a tool grinder.

The time element, subject to the opinion of the foreman, should also govern the matter of a machine hand repairing his own machine. Most shops, of course, have men who are experienced in machine repair and these, rather than the operators, should repair machines.

—Albert Lyon.

Ewing Galloway

HERE a piece, there a piece—simultaneous flashes of searing electrical pyrotechnics—and the panels of another automobile body are welded

WELDING CORROSION-RESISTANT STEELS

E. J. TANGERMAN
Editorial Staff

HERE are summarized interviews with W. B. Miller, metallurgist of the Union Carbide & Carbon Research Laboratories, C. L. Folly, welding specialist of the General Electric Company, A. F. Davis, vice-president of the Lincoln Electric Company, L. W. Hostettler, engineer of the Allegheny Steel Company, W. C. Johnson, president, and A. E. Maskrey, head of the Experimental Department, Industrial Welded Alloys, Inc.; together with material from papers by R. D. Thomas, president of R. D. Thomas & Company, W. B. Miller (ibid), W. L. Warner of the Industrial Heating & Welding Department, General Electric Company, and information from the American Stainless Steel Company, the Krupp Nirosta Company, Inc., Carpenter Steel Company, Allegheny Steel Company, Central Alloy Steel Corporation, and the Crucible Steel Company of America.

Welding with the atomic hydrogen arc

WELDING, known as early as 450 B.C. as an art in the inlaying of metals, is a true paradox of processes, for it is at once one of the oldest and one of the youngest. Until a few years ago, approved welding equipment included a forge of some sort, an anvil, a pan of borax or other flux, a hammer, and a lusty right arm.

Today's welder, who usually carries his equipment to work, rather than carrying the work to his equipment, is a versatile craftsman. The introduction of the newer alloys of iron and steel have given him materials of a quality and a diversity of characteristics that would turn his Damascene predecessor green with envy. With these metals he can fabricate anything from an orange-squeezing machine or a mayonnaise mixer to the glistening sides of New York's newest skyscraper.

The amazing popularity of these corrosion-resistant steels and irons has caused the entry of countless welders and welding concerns into the field, with the inevitable result that all sorts of equipment are being used to make all sorts of welds, some good, but many decidedly bad. The first inference is, of course, that the materials are at fault—no man is willing to admit the fault as his own. One company, now successful in handling these materials, spent five years in development work to reach its present secure position. Only trial and failure can aid in final acquisition of the technique, but these cautions and precautions should not be amiss.

Eternal supervision, careful control, and proper rods and fluxing materials are essentials for success in welding these alloys. Three methods are in favor at present: Oxy-acetylene, atomic hydrogen, and electric arc, either carbon or metallic. Of these, oxy-acetylene was first applied and is most widely used, and arc is usually cheapest because of greater welding speeds. Sound welds,

which when polished show no sign of having been welded, can be made readily. Though the coefficient of expansion of the "corrosion-resistant" alloys is extremely high, being about one and one-half times that of mild steel, this property does not prevent the welding of any of these ferrous alloys to any other weldable metal.

SOME manufacturers recommend pre-heating them to a low temperature (300-400 deg. F.) and using jigs and chill plates to obviate the tendency of light sections to buckle and to reduce the work strain set up in heavy sections by this high coefficient of expansion and relatively low thermal conductivity. Under certain service conditions, stresses produced by welding may be high enough to equal or exceed the endurance limit, which of course results in weld failure. Under certain service conditions, manufacturers recommend that welded pieces be annealed when practicable, thus obviating preheating.

Of the three methods mentioned, gas welding will first be discussed. Many of the precautions described, together with the characteristics of the groups of materials, are also applicable to welding by other methods.

A suitable flux is most important. It allows the use of a neutral flame and blankets the fusion zone, preventing excess atmospheric oxidation or carburization by the flame. Without it, good fusion cannot be obtained at the bottom of the seam. Fluxes of the proper sort have a high solvent power for the oxides formed.

In oxy-acetylene welding both oxygen and acetylene must be controlled carefully, or the carbon content of the weld may be increased. The flame of the blowpipe should be "soft" and neutral or slightly reducing, great care being taken to see that it does not get too far on the reducing side on account of excessive carbon build-up in the weld. It should be only large enough to insure proper fusion and should be pointed in the direction of the welding to pre-heat the work. Puddling should not be attempted. The flame should be kept continually on the weld, to prevent formation of craters or blow holes in the pool. Manufacturers recommend a rod of a diameter approximately equal to the thickness of the sheet being welded up to $\frac{1}{16}$-in. diameter.

Practically all of the newer commercial iron and steel alloys can be divided for gas welding into seven groups, according to chemical composition. Group I, "stainless" steel, is defined by the following composition range: Chromium 12-16 per cent, carbon 0.20 per cent, with other elements in amounts incidental to the method of manufacture. Because of air-hardening properties, welds and metal adjacent will be hard and brittle, which may be remedied somewhat by annealing, followed by slow cooling. After this treatment the metal will not have its maximum stainless properties, developed only by quenching and drawing operations followed by proper surface finishing. Welded steel of this class is usually unsuitable where subjected to corrosion coupled with severe stress or vibration, unless supported.

Group II, "stainless" irons, have 12-15 per cent chromium, less than 0.12 per cent carbon, and other elements incidental to manufacture. The difference between this group and the preceding one lies chiefly in carbon content. Heat-treatment is not required to develop corrosion-resistant properties. Metal is generally furnished in sheet form, flange welds being employed for thicknesses up to No. 16 gage (0.0625 in.). The flanges, preferably about $\frac{1}{16}$-in. high, are painted top and bottom with a special flux, then fused together.

With proper flux and rods of the same composition as the base metal, good welds can be produced in $\frac{1}{16}$- to $\frac{1}{8}$-in. metal without beveling. It is essential that flux be applied to the line of the weld on both top and bottom surfaces. This prevents under-side oxidation and allows good fusion and union to take place under the protecting slag film. Without the flux it is impossible to obtain complete fusion at the bottom of the seam. The rod should be cleaned and painted with a thin flux coating.

In making welds in heavier gages the plate is beveled, flux being applied both to the beveled edge and to the rod, or to the rod alone. Welding should be carried to completion as rapidly as possible and should be performed on one side only. Welding on both sides can be accomplished with the aid of a high pre-heat, but this is not ordinarily recommended. These alloys are air-hardening when heated above their critical temperature, 1,454-1,472 deg. F. (790-800 deg. C.). Heating to 1,202-1,382 deg. F. (650-750 deg. C.) after welding, maintaining the temperature for one-half hour, then cooling in the furnace or in still air, is proper heat-treatment.

Group III iron alloys contain 16-20 per cent chromium, 0.5 1.5 per cent silicon, and less than 0.12 per cent carbon. Higher silicon content facilitates welding. Alloys in this class do not air-harden so readily as those in the preceding ones. They are, however, subject to grain growth at welding temperatures. Annealing at temperatures of 1,202-1,382 deg. F., (650-750 deg. C.), followed by air cooling, imparts weld ductility.

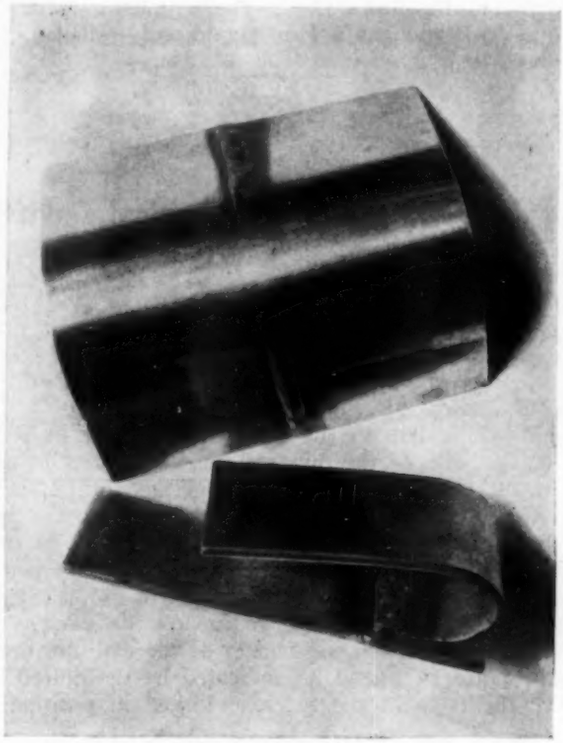
Group IV contains iron alloys with 17-25 per cent chromium and 7-12 per cent nickel, thus including the 18-8 crome-nickel alloys, now by far the most popular. These alloys are austenitic and so are not subject to the brittleness encountered in previous classes. They are in reality irons, and are particularly suited for welded construction, since they require no heat-treatment. No flux is absolutely necessary, but practical results are obtained only through the use of one. For example, single V welds in $\frac{1}{8}$-in. material have been made showing a tensile strength of 80,000 lbs. per sq.in., with 32 per cent elongation in 2 in. over the weld. Ordinarily, plate up to and including $\frac{1}{4}$ in. is not beveled. Weld properties are dependent largely on the quality and physical properties of the metal itself. For example, moderately cold-worked light-gage sheet usually gives higher weld strength than fully annealed material. Water-quenching from high temperatures greatly improves cold-working qualities, but may be applied to only a few products.

Group V, high-chromium, high-nickel alloys, includes alloys with 7-25 per cent chromium, 17-22 per cent nickel, and 1-3 per cent silicon. Alloys in this group are welded easily, although in heavier gages care should be exercised to control expansion and contraction. Some are quite likely to be red short and to crack in the weld just after solidification. Welds in these alloys have properties similar to those of the alloys in Group IV.

Group VI includes high-chromium alloys with 20-30 per cent chromium, and less than 0.3 per cent carbon. They are characterized by unusual resistance to chemical corrosion and high-temperature oxidation. The high chromium content presents some difficulty in welding, particularly on heavy gages, because of the formation of a non-fusible oxide or slag. With a proper flux, as previously outlined, satisfactory flange and butt welds can be made. These alloys are not self-hardening, but grain growth occurs at welding temperatures. Welds and adjacent metal have strength but little ductility.

Group VII includes high-chromium castings, some containing appreciable amounts of nickel or silicon, or both, and considerably more carbon than forged products. In welding, it is preferable to preheat to a good red heat to avoid cracking. Cooling should be relatively slow; further heat-treatment may be necessary to produce proper hardness. Welding rods of the same composition as the base metal should be used. An excess-acetylene flame aids in welding and is allowable because of the high carbon content.

Arc-welding has been applied most successfully to alloys containing both chromium and nickel, i.e., Groups IV and V. These groups are readily arc-welded and



Butt and lap welds in 10-gage stock. Speed, 1 ft. per min.; cost, 6c. by machine, 12c. by hand

may be differentiated from the others easily by the fact that they are non-magnetic when annealed. Technique and results should be checked carefully when alloys not containing nickel are welded with the arc, whether carbon or metallic. Results in many cases have been unsatisfactory, but careful control of technique will often help.

There are two types of chrome-nickel alloys, one containing under 0.15 per cent of carbon, the other containing over 0.20 per cent. Although either class can be metallic arc-welded, the higher carbon alloy must be annealed after welding to gain maximum corrosion-resistant qualities and necessary ductility. Special procedure usually followed in arc-welding is that of laying the first bead down in the usual manner, but starting the second about an inch or more away from the end of the seam, thus giving the effect of an open end to relieve contraction strains. In welding seams on both sides, the same procedure is followed. In butt welding, plates are usually spaced apart a distance equal to the plate thickness.

Actual welding procedure employs the same technique as in arc-welding mild carbon steels. The operator must, however, use reversed polarity, that is, the electrode must be connected to the positive pole of the welding generator, and the work to the negative pole. The metal is laid down with a smooth, over-lapping weave and without puddling. Puddling will result in coarse weld grain structure. Proper welding current should be determined by making a few test welds and examining them to see that proper fusion is obtained. The arc length should be as short as possible in order to minimize the danger of oxidation of the weld metal while passing through the arc stream. In general, arc amperage will be appreciably lower and arc voltage will be apparently somewhat higher than would be obtained on similar work for mild steel welding.

Electrodes for the chrome-nickel, low-carbon alloys are coated, the core being of approximately the same analysis as the pieces being welded. If, however, a rod of the same analysis as the parent metal is used to weld the high-carbon alloys, the resulting weld will have absolutely no ductility. They may, however, be welded with a properly prepared 18-8 chrome-nickel rod.

Electric welding requires a power input line that does not have too great a variation. Precautions as noted for gas welding apply also in using the arc. Spot, roll, and electric compression butt welding may be done readily. The work should be arranged in any case so that welding will be done in the direction from which the current is flowing. One bead should not be laid over another until the slag is removed.

One production shop, for example, is now welding with the arc some 50 or 60 alloys in this class, and welds $\frac{3}{8}$-in., 28-chrome alloy successfully. Their creed is eternal supervision. Each welder takes a weekly performance test. The welded pieces he submits are planed to half thickness and examined with a glass. One pin hole in the weld cuts his efficiency to 90 per cent, two pin holes make it 80, and so on. On this basis his bonus is awarded. All welds must be capable of standing a 180-deg. bend and of being flattened either along the line of the weld or across it. Included in the products of this shop are 6-in. tubes, 25 ft. long, which will see service at 2,000 deg. F., pressure tanks 11 ft. in diameter by 24 ft. long of $\frac{7}{16}$-in. material; and a wide variety of tanks, hoppers, screw conveyors, milk pans, and similar equipment for the food industry. The importance of eliminating pin holes in the welded seams is emphasized since the purchasers of these products will not accept any article showing a pin hole in the weld.

Carbon arc welding has been applied successfully to the alloys containing nickel. In using this method, the polarity is not reversed. This prevents the addition of carbon to the weld, the carbon passing off in gaseous form after combustion in the arc. Flux can be applied directly to the material, but it has given better results when fed into the arc. Arc length is usually somewhat shorter and welding speeds are often greater than those obtained with the metallic arc.

General instructions applied to welding by other methods are also applicable to welding with atomic hydrogen. Fluxes are not required ordinarily because the molecular hydrogen flame surrounding the weld areas prevents oxidation, and also because of the high temperature, reducing, and heat-transferring flame properties.

Oxide formed during the welding operation should be removed, no matter what the welding method, as it will tend to discolor almost any metal. This can be done by scraping, wire brushing, or pneumatic hammering.

IDEAS FROM PRACTICAL MEN

Concavities and Convexities
Discussion

JOHN J. MCHENRY

FOR the past twenty years, the *American Machinist* has been a constant friend and a close acquaintance of mine. Now and then an article has appeared which struck a responsive chord in my makeup, and I have discussed it, usually under a pen name.

The present article is my first contribution to the *American Machinist* in about ten years. It was brought about by reading the article concerning a device for spherical turning, so well described by Fred Pfuchler, on page 381, Vol. 72, of that journal. The article interested me because I had used the same device many years ago. Also, I think Max Schwarze's device, described on page 380 of the same issue, is a most practical one for attaining the results he was after.

The accompanying illustrations show some methods of producing spherical and irregular shapes. A fast and accurate method of milling a ball on the end of a shank is shown in Fig. 1. While the shank carrying the ball is revolved, the hollow cutter is fed down on the rough ball at an angle that will permit it to finish the ball, excepting that part held by the shank. The cutter, of course, revolves.

A practical, easy, and accurate method of lapping a ball is shown in Fig. 2. The end of the tubular lap is charged with abrasive and is held in contact with the ball. By reciprocating the lap as it revolves, as indicated by the curved arrow, the ball will be lapped spherically with a high degree of accuracy.

Grinding wheels can be formed for the reproduction of tools by the method shown in Fig. 3. Work out the shape wanted on a steel roll, and cut a number of slits in it about $\frac{1}{16}$ in. wide and $\frac{1}{2}$ in. apart; then harden it. With the roll mounted as indicated and placed on the table of the grinding machine, bring the roll and the wheel into contact. Revolve the wheel slowly by pulling the belt, feed the roll carefully into the wheel, and the wheel will gradually take a shape opposite to that of the roll. Do not attempt to revolve the wheel by power. Even the finest tool marks will be transferred to the wheel. A supply of compressed air is a great help in blowing away the grit during the operation.

It is well to have a generous supply of wheel arbors and to keep the formed wheels on them, so they will not have to be trued each time they are used.

A very practical method of turning irregular shapes is indicated in Fig. 4. The illustration shows the device so clearly that no further explanation is necessary. However, it should be borne in mind that the indicator following the templet must have a sharp edge, and that the cutting tool should have a reasonably sharp point. A diamond-point tool is excellent for the purpose. This method is the best I have used for unusual shapes that seldom require duplication. The templet is made from $\frac{1}{32}$-in. stock and has a $\frac{1}{8}$-in. round, cold-rolled stiffener soldered to it.

Generating a Hemispherical Cavity

VINCENT J. ZUANICH
Toolroom Foreman, Hall-Scott Motor Car Company

In developing a two-part mold for a solid rubber ball, the cavity in each half of the mold was generated in a universal milling machine, using an end mill held in the vertical attachment, as shown in Fig. 1. The blank for one-half of the mold was mounted in a chuck on the spindle of the dividing head, the head being set at an elevation of 45 deg., and operated by power.

First, the blank was bored in the lathe to the angles indicated at *A*, Fig. 2, so that it could be set in proper relation to the end mill at the start. The diameter of the end mill was the same as the length of the chord of 90 deg. multiplied by the radius of the cavity. The work was set so that one corner of the end mill touched at the point *B*, Fig. 3, as indicated by the dotted lines. With the table of the machine locked in position, and

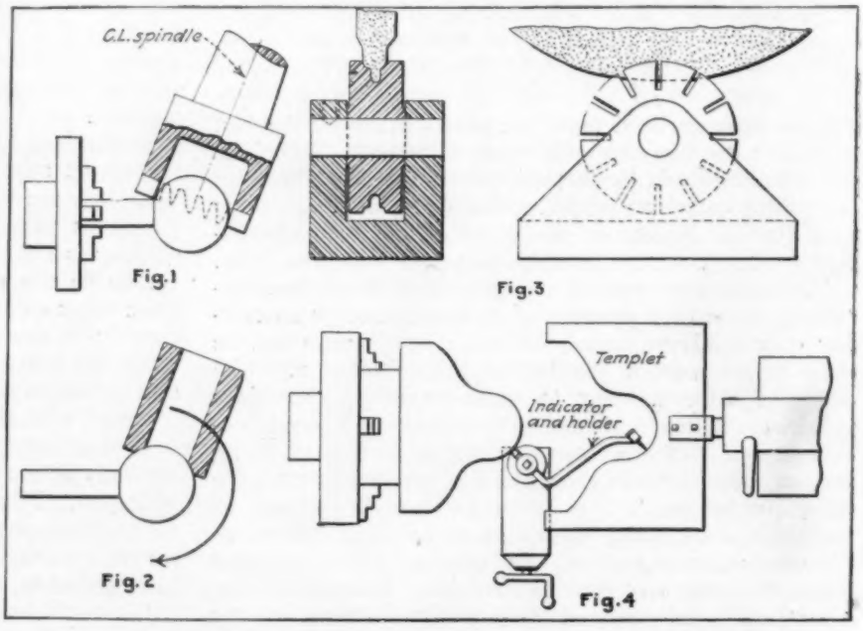


Fig. 1—Milling a ball attached to a shank. Fig. 2—Lapping a ball so that it will be truly spherical. Fig. 3—Method of forming a grinding wheel. Fig. 4—Turning irregular shapes by means of a templet and an indicator

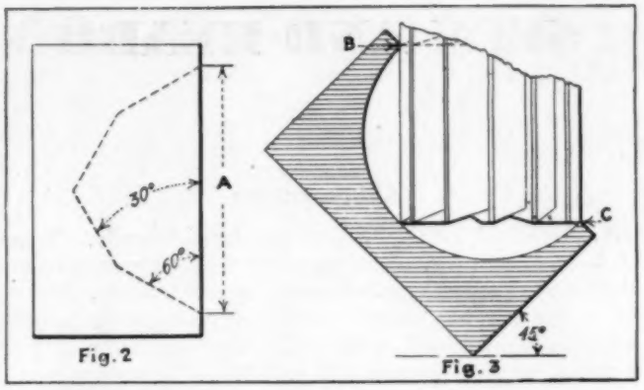


Fig. 2—Preparation of the half-mold for setting the cutter. Fig. 3—Diagram showing the cutter in relation to the work

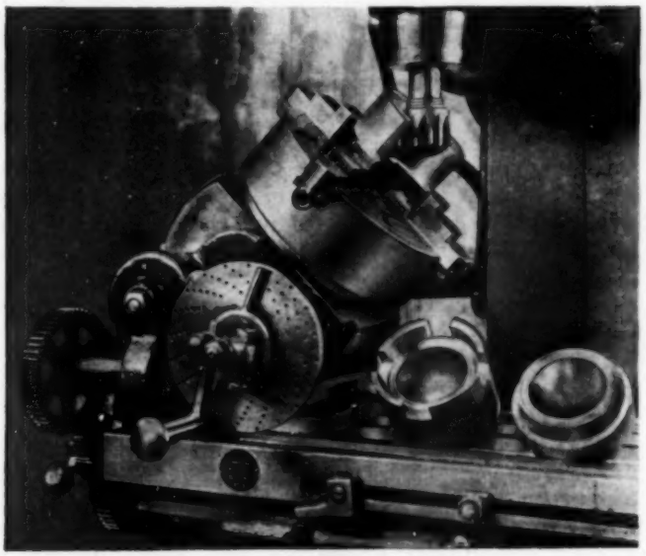


Fig. 1—The set-up in the milling machine

both the end mill and the work revolving, the table was fed upward very slowly, the feed being stopped when the end mill touched the point *C*. The result was that a hemispherical cavity was milled in the work, as can be seen by the halves of the mold on the machine table. To better show the result of the operation, part of the half-mold in the chuck in Fig. 1, has been cut away.

■

Double-Acting Tools for a Press
Discussion

THOMAS SMITH
Nottingham, England

Referring to the article by C. W. Hinman, under the title given above, on page 961, Vol. 72, of the *American Machinist*, I should like to congratulate the author on the very ingenious tools described for making the product shown. However, as a practical designer and maker of dies, I feel sure that the tools will not work well.

While the outside measurement of the finished work is $4\frac{3}{4}$ in., that of the blank is $5\frac{1}{4}$ in., allowing $\frac{1}{4}$ in. for each of the 30-deg. turned-up edges. After these edges have been turned up they will measure about $4\frac{1}{2}$ in. across, and this is the size the punch should be made if it is to leave after the angle has been formed. Every diemaker knows that the punch corner is where the bend will be made in any push-through bending die, such as the one described. Thus, the straight walls shown in black will be far from vertical, and when they strike the shell *D*, they will tend to curl back and buckle the work at the bottom. If they did not curl back, the bottom would show two distinct corners. The job is a very simple one, and the tools, while ingenious, are too expensive unless a very large output is required. We make large quantities and many sizes of the kind of work described by Mr. Hinman, and all are made by one set of tools, the procedure being as follows:

Sheets are trimmed on the two edges and pieces of the required length are cut off and trimmed to the proper length. All cutting and trimming is done at a labor cost of $2\frac{1}{2}$ pence per gross of blanks. Notching is done in an adjustable notcher, using simple tools, at a cost of $\frac{1}{2}$ penny per gross. The blanks are then put through a foot-operated angle bender. This machine turns up the four edges, leaving sharp corners and flat bottoms, at a cost of $1\frac{1}{2}$ pence per gross. Thus the total labor cost is only $4\frac{1}{2}$ pence per gross. The tools used are all stock tools and can be used for many sizes. Therefore, while I think the tools described by Mr. Hinman are very good on paper, I would never think of making them to do the very simple job described.

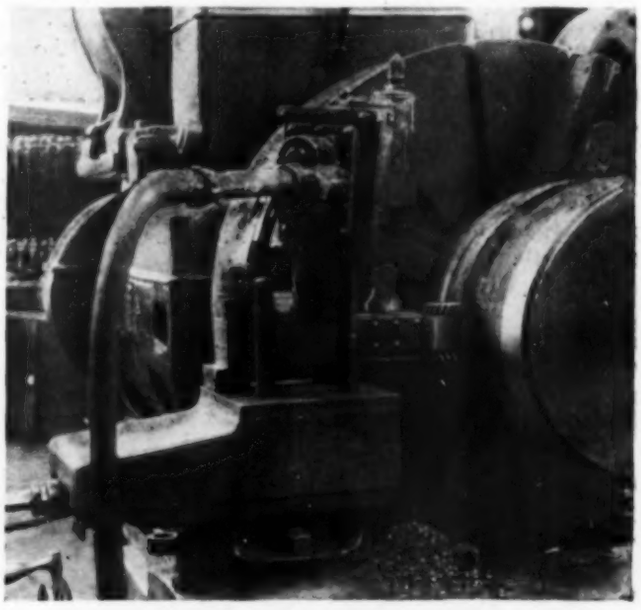
■

Lathe Attachment for Squaring Valve Ports

FRANK J. OLIVER, JR.

The illustration shows a device mounted in the toolpost of a lathe for squaring valve ports in locomotive valve bushings while chucked on the faceplate. Formerly, these ports were filed out—an operation consuming about two hours; with this home-made milling attachment, ten ports can be done in 15 minutes. Indexing is accomplished by turning the faceplate by hand.

In essence, the unit consists of a pair of reverse spiral



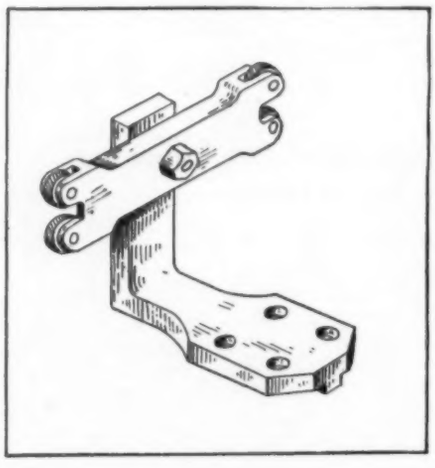
millers driven by an air motor through a train of spur gears. The air motor is mounted on a strap which is bolted to the body of the tool through the regular tool-post studs, and it drives through a universal joint. One of the chief difficulties in the first unit built was gear wear, the solution being the use of coarse pitch gears of stub tooth form, made of nickel steel. A further refinement was the adaptation of Timken bearings for the gear shafts. This device is in use at the Omaha (Neb.) Shops of the Union Pacific Railroad at the present time, and has proved itself equal to every demand made upon it.

■

Knurling Tool for Use in a Turret
Discussion

RALPH J. THOMPSON

In an article under the title given above, on page 229, Vol. 72, of the *American Machinist,* Charles H. Willey, in describing a knurling tool, says it can be used with straight knurls only. As I have used such a tool as described by Mr. Willey, but equipped with right- and left-hand knurls, I am sure that he does not know what a handy tool he has developed. The illustration shows a knurling tool that I have successfully used in a turret lathe, mounted on the cross-sliding flat turret. It is mounted on a bracket made from a piece of angle steel, and is planed on the bottom to fit one of the grooves in the face of the turret. The vertical web is planed to the same thickness as the width of the knurls. Two plates of hardened steel are pivoted near the top of the vertical web, one on each side, and knurls of different pitch are mounted at both ends. The plates are reversible, so that either pair of knurls can be brought into use. A tool of this kind may be made to skip the ends of the work, leaving them plain, making a better-looking job than if the work knurled its full length.



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Heat-Treating Tables
Correction

In the heat-treating tables published as a reference-book sheet in the *American Machinist* on page 367, Vol. 73, one figure, that for mercury, is incorrect as it appears. Instead of 173 deg. F., the solidification point of mercury is minus 38 deg. F., and its boiling point is plus 676 deg. F.

SEEN AND HEARD

●

Abbreviations

ABBREVIATIONS affect people differently. Some consider them an abomination while others welcome them as a time saver in both speaking and writing. Duralumin has become "dural" in shop practice, and includes all aluminum alloys, incorrectly, however, since it is a trade name. Aluminum still is called by its own name.

Over in England, where as a rule abbreviations are not in favor, I've heard tool makers refer to thousandths as "thous." And some in our country refer to them as "mils," as do the electrical men in speaking of wires.

Recently in the West, I heard lubricating oil referred to as "lube oil," either as two words, or run into one, as "luboil," which saves a lot of breath and ink in the course of a year. It might not be a bad idea for the A.S.M.E. to set a committee of practical men at work on abbreviations of long words in common use in manufacturing. Professors of English would have to be barred, because the object is to get smooth sounding, short words of unmistakable meaning, regardless of their relation to what we have called good English.—*J. R. G.*

Consistency in the Shop

CONSISTENCY appeals to men in the shop even if they don't wear titles or college degrees. I recently ran across a case where two time-study men and the superintendent himself were checking a simple operation on a small machine. One man held the watch, the other had a formidable looking pad for the record, and the super played the part of the audience.

The men got the idea that if the boss wanted real efficiency this should have been a one-man job. They couldn't see the consistency of having two high-priced men and the super for a simple job and the reaction wasn't at all favorable. It's a good thing to get the view point of the man in the shop if you want to get his co-operation. —*J. R. G.*

Shop Transportation

PRODUCTION men, who experience the old difficulty of getting all parts to the assembly floor promptly, often discover that more time is lost between operations than is actually consumed in machining. Usually it is not the big castings, requiring crane service, that fall by the wayside—the smaller parts carried in tote boxes and shop trucks are often more troublesome.

Much time can be saved by a distinctive method of marking work ready to leave the department, such as a move ticket, and education of the truck operator. In fact, I have seen a truckman, who after being properly impressed with the necessity of handling material promptly, pick up a box he had left on the previous trip, before the foreman had checked it in from the prior operation. Of course, this is working too fast, but more often the tendency is in the opposite direction, resulting in the loss of valuable time. —*J.*

Hardening Tools

FUNDAMENTAL HARDENING RULES

HEATING is to be done gradually and penetratingly, until the whole section of the part of the tool to be hardened has reached the right hardening temperature of the particular steel used. The tool should be kept at the hardening temperature only long enough to permit thorough heating.

The tool should then be hardened in accordance to its requirements more or less vigorously by quenching in a suitable hardening medium. Temper can be drawn if required.

FREQUENT FAULTS IN HARDENING

Fault in Hardening	Appearance of the Tool Resulting from the Fault	Appearance of Fracture	Possible means of Correcting the Faults of Hardening
The tool has been heated insufficiently, i.e., has not been heated at the correct hardening temperature	Has not been hardened or is insufficiently hard. Has retained it's scale wholely or in part. Can be filed	Has more or less the appearance of unhardened steel	Hardening is to be repeated at a higher temperature
The tool has been heated to above the correct hardening temperature, i.e., overheated	Sufficient hardness; normal amount of scale; cannot be filed. The tool may crack easily during hardening owing to insufficient toughness. Breaks away during use	Varying from fine to coarse grain, in some cases glittering; occasionally stony appearance	Should the overheating be only slight, hardening can be repeated at a lower, i.e., the right, temperature. Should the heating, however, be greater, the steel should be annealed beforehand and then rehardened. If, as with chisels, the form of the tool will permit it, the steel should be reforged
The tool has been very severly overheated, i.e., burnt	Sufficient hardness; normal amount of scale; cannot be filed. Owing to lack of toughness, the tool cracks and breaks out easily during use	Coarse grain to coarse crystalline, strong white sparkle	A burnt tool cannot be rendered serviceable
The tool has not been sufficiently protected against decarbonization of the surface during heating	Has apparently not taken sufficient hardness; imperfect scaling; surface can be filed; beneath soft decarbonized surface proper hardness is often found	A wider or narrower edging, depending on the intensity of the decarbonisation, will show on the outside. This edging will be very sparkling and resemble cast iron. Below it the grain will be in accordance with hardening	Grind away the decarbonized surface If this is not possible and the decarbonisation is not deep, the tool may be annealed in a case-hardening material (i.e., carbonized leather) and then rehardened. Should the decarbonisation be deep, anneal and reforge the piece and then harden afresh
The tool has been heated too quickly and irregularly	Unequal hardness (the edges are generally sufficiently hard), imperfect scaling. Can be filed in places. The tool cracks easily, corners or teeth break out with shell fractures, large pieces burst	Unequal appearance. Partly unhardened, partly properly hardened. Often overheated grain on edges and thin portions	Anneal and reharden correctly
The part of the tool to be hardened has not been cooled suddenly enough, either because the hardening medium has become too warm or because a wall of steam has been allowed to form between the tool and the hardening medium	Insufficient hardness, especially with large pieces. Edges are generally hard. Surfaces, particularly large ones, can be filed, however, even though they scale properly	Only edges and thin portion properly hardened, otherwise—particularly on the surface—unhardened or not quite enough grain	The hardening is to be repeated, care being used that the cooling takes place rapidly enough, either by the use of a spray or blast pipe or by moving the piece about in the hardening medium. Complicated pieces should be annealed beforehand
The tool has been hardened in a hardening medium (e.g. oil, air, etc.) which was too mild for the quality of the steel, or for the particular purpose for which the tool is required	Insufficient hardness; edges and thin sections sometimes hard; larger sections and surfaces soft; generally insufficient scaling; can be filed in parts	Resembles at the soft parts more or less the fracture of the unhardened steel	Hardening is to be repeated in a stronger hardening medium
The tool has been hardened in a hardening medium (e.g brine) which was too strong for the quality of the steel or for the particular purpose for which the tool is required	Proper hardness, normal scaling, cannot be filed; hardening cracks appear; great distortion; tool is brittle	Hardening grain is good; very deep; sometimes shows complete hardening	Relieve the brittleness by drawing the temper

The Natural Fracture of the Tool Steel (*unannealed, unhardened*) should show an even gray, dull grain, which is coarse with soft steels and finer with hard steels. Alloy steels show a facture in accordance with the alloy used and have a more or less velvety appearance and a coloring of their own.

The Fracture of Annealed Tool Steel—Through proper annealing the texture of the steel becomes brighter, the fracture is more regular, the grain rather fine. The brightness, however, is easily distinguishable from the sparkling brightness of overheated steel.

The Fracture of Badly Annealed Tool Steel—Insufficiently annealed steel has a fracture more or less like the natural fracture. Over-annealed steel has a coarser crystalling and very brillant fracture. Should air have penetrated to the steel during the process of annealing, the fracture will show, on the surface, a decarbonized edging resembling cast iron.

The Fracture of Hardened Tool Steel—The fracture of the hardened layer of a properly treated steel will have the finest grain that it is possible to attain with the particular quality of steel, used. This grain will be very fine, velvety, and dull. The differences of grain between a soft and hard steel will almost entirely disappear at the hardened layer. The fracture of alloyed steels will have a particularly fine dull texture. Depth of the hardened layer depends on the chemical composition of the steel and, in some qualities also, on the manner of annealing.

The Right Hardening Temperature—of a steel is the lowest temperature at which the steel will take a good hardness. At this temperature the steel will have the best combination of hardness and toughness. If treated at a higher temperature, it, will simply lose in toughness without gaining in hardness. This correct hardening temperature is not the same in all qualities of steel.

The Right Tempering Color—is the one by which the tool obtains sufficient toughness for the purpose for which it is intended while retaining the greatest possible hardness.

Courtesy of Weston Electrical Instrument Corporation

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Will You Be Sitting on the Side Lines?

MANAGERS who are simply waiting for business to improve may find themselves sitting on the side lines when new orders begin to flow in. Wages, according to statistics, have not been materially decreased. Prices of commodities have, however, been lowered in many lines to stimulate buying and to move existing stocks. These prices are not likely to be raised in the near future. These conditions mean lessened profits unless steps have been taken to reduce costs by improvements in methods and equipment.

Managers who are alive to the situation are not idle. They recognize this as the ideal time to make profitable investments in new machinery and to reorganize methods. They are weeding out obsolete practices, simplifying forms for keeping records, rearranging machines and departments to minimize lost motion, and otherwise improving their positions for economic manufacture. It is a good time for managers to be sure their houses are in order.

Cheaper in the End

BECAUSE of a lack of a sufficient number of heavy machines of a certain type, a machinery builder recently had to contract out some of his work that was assigned to these machines. One contract shop charged two and a half dollars an hour for its work, another charged four dollars.

When the work came back, that from the four-dollar shop was practically perfect, considerably better than that from the other shop, as was to be expected. But when the bills for the work came in the charge of the high-priced shop was eight thousand dollars while the charge of the other shop, for the same total amount of work, was over nine thousand dollars.

Which just goes to prove once more that the expensive man, or machine, is likely to be more highly skilled, and cheaper in the end.

Safety as an Investment

SAFETY devices and accident prevention campaigns were formerly supposed to reduce production by making men slow up, thus making them more careful. Recent information seems to show just the opposite effect, and in many instances the dividends of safety are large.

The American Smelting Corporation, for example, reports that it has decreased its former accident rate by 76 per cent and saved nearly $2,000,000 at the same time. The Buick Motor Company officials feel that they have saved $300,000 and protected between two and three thousand men, while the United States Steel Corporation, which has many millions on its safety work, figures the return at $5,000,000.

The cost of accidents is large. Mr. H. W. Heinrich, of the Travelers Insurance Company, states that the indirect losses from accidents are four times as great as the direct losses. This is not an estimate, but the result of an analysis of five thousand cases that are on his records. With such a showing the safety idea should be a prominent part in all managerial planning.

Preparation, Courage, and Success

IN NO instance has the value of careful preparation been more clearly demonstrated than in the highly successful non-stop flight of Costes and Bellonte from Paris to New York. Careful planning, thorough testing of plane and instruments, above all, the patience to wait for favorable conditions, have their reward in as nearly perfect a flight as can ever be expected.

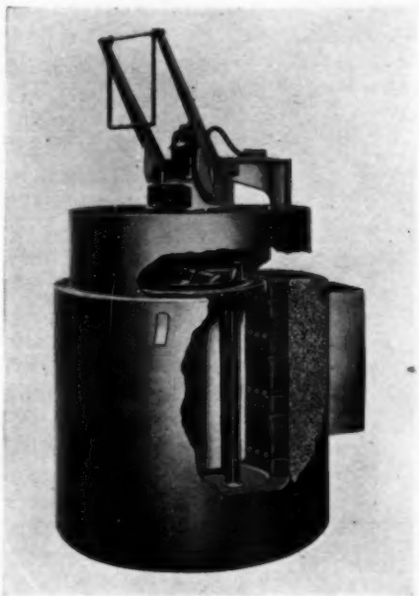
From a practical point of view, the outstanding feature of the flight is the courage that could withstand criticism of numerous delays, that could turn back as Costes did last year, and yet hold steadfast in his purpose until the time was ripe. There is no question of his skill as pilot and navigator. Few indeed possess the other characteristics that make for complete success. And these characteristics are of more value to real progress in air transport than any amount of spectacular or dare-devil acrobatics.

Aviation owes its hearty congratulations to the men who waited until the flight could be made and was made with complete success.

SHOP EQUIPMENT NEWS

General Electric Air-Draw Furnace

The General Electric Company, Schenectady, N. Y., has announced an air-draw furnace, which will be exhibited for the first time at the National Metal Exposition. The furnace is designed for drawing steel at temperatures up to 1,200 deg. F., and embodies the same heating unit construction as that employed in

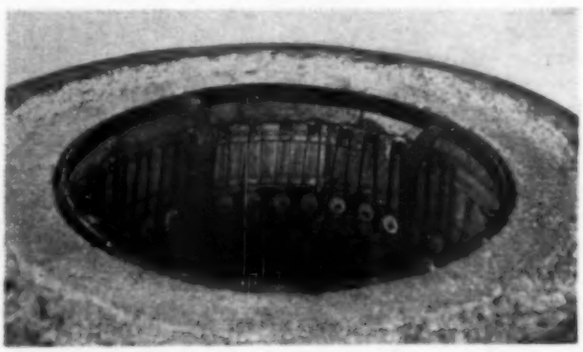


higher temperature G.E. heat-treating furnaces. The heating units are of heavy nickel-chromium ribbon, located on the inside wall of the furnace and so placed that they present a maximum of surface area to the air. A fan of heat-resisting alloy circulates air in large volume through the charge. Positive automatic control of the temperature of the air is provided. The wall of the furnace chamber is of lightweight refractory backed with heat-insulating material and protected by a welded casing. The cover consists of an outer steel shell and an inner alloy-steel lining with insulating material between them.

Parts to be tempered are placed in a basket, and the basket lowered into the furnace. Alloy guards are provided in the furnace for guiding the basket in and out. The cover in which the fan is located is swung and lowered into position by hand. A limit switch provided on the cover throws on the power and fan when the cover is closed. When the cover is open, power is interrupted, and the fan is stopped.

The high-pressure fan forces a large quantity of air down through the charge and up over the heating units. A thermocouple is located in the path of the air after it leaves the heating units, so that temperature of the air entering the charge is controlled definitely at all times. These features provide uniform results and rapid heating of the charge.

By using an auxiliary cover and a suitable retort, the furnace may be used for nitriding. An insulated cover, similar to the standard cover, is available with a large hole in the center through which a nitriding retort is inserted.



Interior of General Electric 18 x 22-In. Furnace, showing guide rack for basket

"Durez" Varnish for Castings

To prevent corrosion of certain ferrous and non-ferrous castings, an application of "Durez" No. 278 varnish may be used to overcome porosity. This material, developed by General Plastics, Inc., North Tonawanda, N. Y., is a special "Durez" varnish that is being applied to automotive, radiation, electrical, and compressor castings to prevent corrosion, seepage of oil, leakage of compressed air, or leakage of liquids under pressure. It retards corrosion from sea water, dilute alkalies, acids, ammonia, and certain anti-freeze compounds.

Application may be carried out in various ways, depending upon the type of box and the result desired. The general practice is to impregnate the pieces under pressure, sometimes after a vacuum treatment, and perhaps heated for a slight expansion, drained, air dried, and baked. The baking temperature is comparatively low, 250 to 300 deg. F., for a sufficient period to heat the casting through. Sand blasting or wire brushing may be employed on the casting before the application. Since the amount used is small, the material cost is slight.

Oxweld Two-Stage Oxygen Regulator

Constant welding line pressure is given by the two-stage oxygen regulator placed on the market by the Oxweld Acetylene Company, 30 E. 42nd St., New York, N. Y. This

Oxweld Type R-43 Two-Stage Oxygen Welding Regulator

two-stage reduction is accomplished through two separate and independent sets of diaphragms, valves and springs. The full cylinder pressure of 2,000 lb. is transferred to the regulator through a stem-type valve and is controlled by the first-stage diaphragm. Here the pressure is re-

duced to less than 250 lb. per sq.in., and is non-adjustable.

From the first reduction chamber the oxygen passes to a second stem-type valve and diaphragm assembly, where the pressure is reduced to the working pressure desired by the operator. An adjusting screw regulates the working pressure.

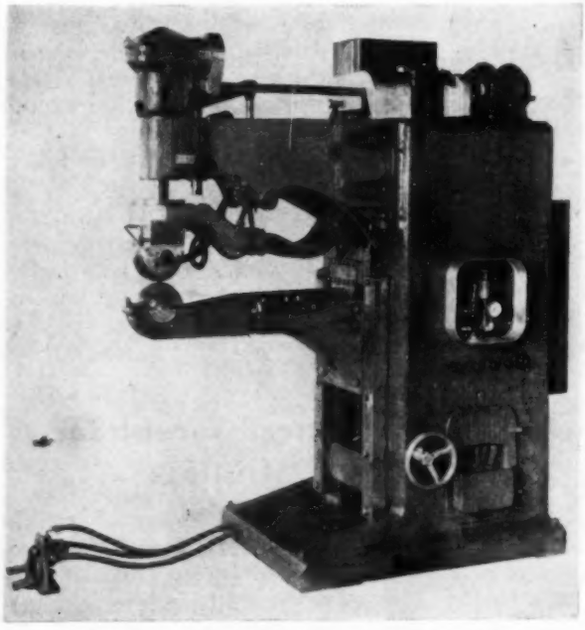
Instead of the usual handle-type pressure adjusting screw found on other Oxweld regulators, there has been substituted a screw with a ribbed cap to present neater and more compact appearance and to avoid the possibility of breakage, as there are no projections on the handle to be bent accidentally. This adjusting screw is of smaller diameter than the body of the regulator itself.

Thomson-Gibb No. 4 HDA Seam Welder

Among the equipment to be exhibited at the National Metals Exposition next week, is the No. 4 HDA seam welder developed by the Thomson-Gibb Electric Welding Company, Bay City, Mich. Several features growing out of the automotive practice have been incorporated in the machine. Although the driving welding roll revolves slowly, the shaft and gears effecting the drive are designed for moderately high speeds, and the worm reduction unit is placed as close to the welding roll as possible. Another feature is that replacement of parts can be done with the least loss of welding time. Also, the driving mechanism is made up of independent units so that they may be suitably housed for lubrication purposes and removed easily to a work bench for repair, in order to accomplish such work more speedily than can be done on the machine. Independent circuits of circulating water are used to cool the various parts of the machine.

The base is a single casting, the column being cast integral, thus affording a sturdy foundation for the several units. The driving mechanism consists of a motor, a 4-speed change gearbox for the welding speeds, a worm reduction unit, a driving head unit, a three-speed change gearbox for changing the interrupter speeds, and a current interrupter. Drive for 4-speed gearbox is through spur gears, the motor pinion being of Micarta to eliminate noise. Protection to the drive is provided by a cast aluminum guard.

Drive from the change gearbox to the worm reduction unit is through spur gears, one being non-metallic. Spur gears are employed to provide a flexible drive, because smaller or larger welding rolls may be required for special work, although the actual welding speed per minute must be maintained. The worm reduction unit in turn drives the upper welding wheel through a vertical shaft, mounted on ball bearings, and a set of bevel gears next to the upper welding wheel. Drive to the 3-speed change gearbox for the interrupter speed is effected by means of a roller chain from the worm gear reduction shaft, and this drive is arranged so that the welding speed can be changed without altering the number of current interruptions per inch of weld. If desired, however, the number of interruptions per inch of weld can be changed by means of 3-speed interrupter change gearbox. A cast-aluminum guard also covers this drive. As in the other drive, a set of two spur gears, one of which is non-metallic, connects the 3-speed interrupter change gearbox with the interrupter. Both gearboxes and the worm reduction unit are totally inclosed and run in an oil bath. Timken tapered roller bearings are provided throughout.



Two thicknesses of No. 14 gage can be welded at the rate of 6 ft. per min. on the Thomson-Gibb No. 4 HDA Seam Welder

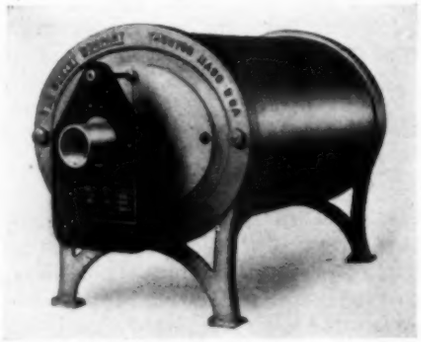
An extra upper welding roll and shaft assembly are furnished as standard with each machine so that lost welding time will be only that of changing from the worn to the retrimmed assembly. A special lathe adapter with a standard taper shank to fit the driving head of the lathe is also furnished as standard with each machine and facilitates redressing of the welding roll. Either a straight- or a circular-seam lower arm can be placed in the lower arm holder. The upper welding head will swivel into position, allowing the machine to seam either straight or circular seams as desired.

Vertical movement of the upper welding roll assembly is afforded by a double-acting air cylinder, mounted in the upper arm casting. An adjustable compression spring is attached to the operating lever between the air cylinder and the upper welding head spindle, and is mounted on a ball thrust bearing to facilitate adjustment.

A remote control switch, actuates the main contactor for controlling the welding current and is attached to the compression spring lever. It is so designed that it will not operate until the spring exerts enough pressure on the work to prevent arcing as the rolls touch the metals to be welded. This switch is fully automatic in action and requires no adjustment regardless of the stroke used or the wear of the welding rolls. A foot-operated valve controls the air and can be moved to any position convenient to the operator. An automatic air line lubricator and an air pressure regulating valve and gage are also provided as standard.

Sentry Model "U" Tube Furnace

A small electric tube furnace for operating at higher temperatures than the conventional type has been placed on the market by the Sentry Company, Taunton, Mass. This Model U furnace is designed for combustion analysis and similar work, although it may be used for small tool hardening. Temperatures up to 1,400 deg. C. (2.252 deg. F.) can be withstood and a porcelain tube can be furnished



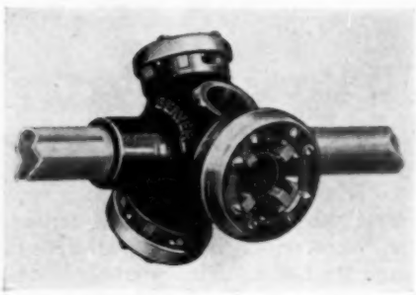
Sentry Model U Tube Furnace, which has a normal temperature range from 700 to 1,400 deg. C.

which will not deteriorate at 1,500 deg. C. The furnace is arranged to receive a tube 1½ in. in bore x 1¾ in. outside diameter, and has a heating chamber 9 in. long. Silicon-carbide heating units are employed. The terminals are composed of a special heat-resisting alloy and are air cooled.

A rneostat is supplied to regulate the rate of heating or of holding the furnace at any desired temperature. The normal heating time at 800 deg. C. is 30 minutes, and for 1,300 deg. C., 2 hours.

Beaver Nos. 33 and 34 Three-Way Die Stocks

Two three-way die stocks, the No. 33 with dies for ⅜, ½, and ¾ in. and the No. 34 for ½, ¾, and 1 in., are available from The Borden Company, Warren, Ohio. These die stocks are companion tools of the No. 3 "Beaver Jr." ratchet, the dies and caps being interchangeable. Die segments are square in shape and are not weakened by shoulders or offsets, and thus the tip will not break off. Dies are driven



Beaver Three-Way Die Stock

by the solid body of the tool and not by a cap held on the body by screws. The die retaining ring is of pressed steel. Extra-heavy and extra-long handle bosses are provided so the handles will not work loose.

The full width dies are suitable for threading steel, wrought-iron, or brass pipe, and can be inverted for threading short nipples. Balance is achieved by the three-way construction, which permits easy handling and use of the die stocks.

"Hicycle" Portable Electric Tools

Five additions have been made to the line of "Hicycle" portable electric tools manufactured by the Chicago Pneumatic Tool Company, 6 E. 44th St., New York, N. Y. These are as follows: The Nos. 12 and 13 drills, the Nos. 12N and 13N screw drivers, and the No. 12G die grinder.

None of these tools weigh more than 5 lb. and are balanced, thus enabling the operator to work without fatigue while holding the tool with one hand. Other features of these tools are the heavy gearing, the oversize ball bearing construction, and a simple switch. The "Uniloy" jointless rotor has no electrical joints. Because of this feature and the replaceable shaft, repair expense should be brought very low.

The Nos. 12 and 13 "Hicycle" drills are designed for drilling to $\frac{3}{16}$ in., and are particularly suitable for airplane work, automobile body trim departments, metal furniture, steel shelving, and sheet steel filing cabinet work. Both weigh less than 4 lb. and are 9½ in. or under in overall length. The No. 12, illustrated in Fig. 1, is not provided with an extended grip handle, whereas the No. 13 is. In Fig. 2 is shown the No. 12N screw driver which weighs 5 lb. or less in both models and is 10½ in. or under in overall length. The No. 12N can be held comfortably in the palm of the hand at the end of the device. The No. 13N has an extended grip handle. Fig. 3 shows the No. 12G die grinder with a 2 in. wheel for external grinding.

McIntyre & Kerr Tungsten-Carbide-Tipped Scribers

Two sizes of tungsten-carbide-tipped scribers for toolmakers' and machinists' use, respectively, have been placed on the market by McIntyre & Kerr, 1741 Eighth St., Berkeley, Calif. The tip is claimed not to come loose or crack in service. Being tungsten carbide, it will scratch the hardest tool steels.

Fig. 1—"Hicycle" No. 12 Portable Electric Drill

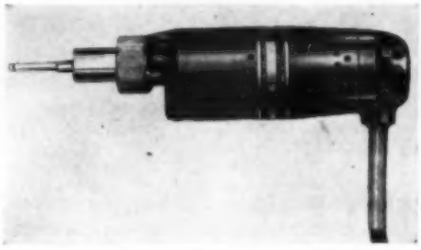


Fig. 2—"Hicycle" No. 12N Portable Electric Screw Driver

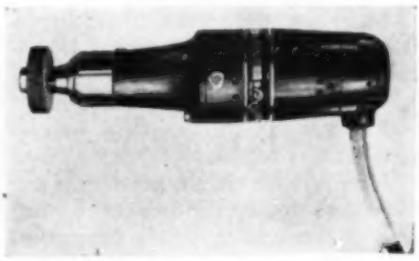
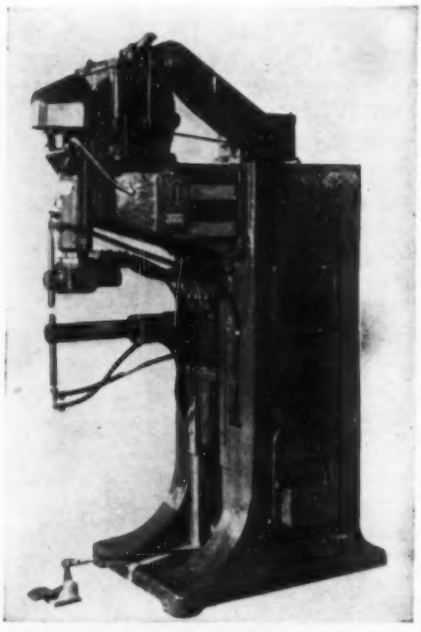


Fig. 3—"Hicycle" No. 12G Die Grinder with 2-in. wheel

Thomson-Gibb No. 2 Press Welder

Another machine to be exhibited at the National Metals Exposition next week by the Thomson-Gibb Electric Welding Company, Bay City, Mich., is the No. 2 press welder, an automatic spot welder incorporating many principles developed by the automotive industry. All fast moving parts are totally inclosed and the complete driving mechanism is mounted at the top of the machine. This reduces the floor space required by approximately 30 per cent, as compared with former designs. Friction is minimized by the use of Timken tapered roller bearings, Hyatt roller bearings, and ball thrust bearings. Standard throat depths are available as follows: 12, 18, 24, 30, 36, and 42 in., and the machines are powered with either a 60 or a 100 kva. water-cooled transformer, affording a maximum welding capacity on the short throat depth machine of two thicknesses of No. 10 gage.



Throats from 12 to 42 in. and five speed combinations for projection welding are features of the Thomson-Gibb No. 2 Press Welder

Short throat depth machines are efficient as projection welders, having capacity to make four projection welds at one stroke on 14 gage stock, the four projections being within a 4 in. radius.

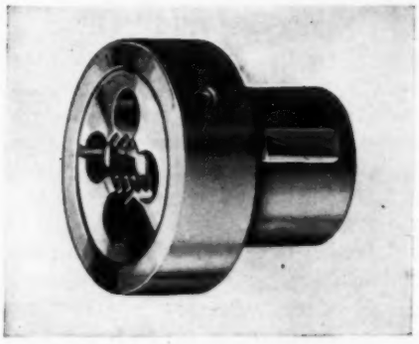
Drive is effected by means of a motor, a four-speed change gearbox, and a worm reduction unit. Spur gears transmit power to the gearbox, the motor pinion being of Micarta to eliminate noise. The gearbox drives the worm reduction unit by means of a Link-Belt silent chain covered by a cast aluminum gear guard. Lubrication of the chain is effected by wick feed oiler. The worm reduction unit is used because it permits of moderately high speeds at the worm shaft, the revolutions being between 835 and 1,760 r.p.m., irrespective of number of spots per minute. When set at the slowest speed, it makes only 15 spots per minute. Any one of five 4-speed combinations are available. The slow speed combination gives four speeds from 15 to 30 spots per minute and the fastest speed from 60 to 130 spots per minute.

A clutch is also mounted on the worm reduction unit, because in so doing it can be inclosed. This clutch has nine engaging teeth and thus gives practically instantaneous operation even at the slowest speed. The entire worm reduction unit and clutch are inclosed and run in a bath of oil. Likewise, the change speed gearbox is totally inclosed and runs in a bath of oil.

The operating cam is mounted directly over the center line of the welding head. Using heavy pressure springs, this machine can deliver pressures up to 2,000 lb. An indicating pressure scale is a standard feature, being located in the welding head to facilitate the recording of pressures for resetting purposes. The remote-control switch cam is now placed on the front end of the operating cam shaft, instead of the rear as on former models. This facilitates making adjustments of the cam to control duration of the current dwell. The cam is of the fan type.

Bolt Dieheads for No. 3 "Beaver" Die Stock

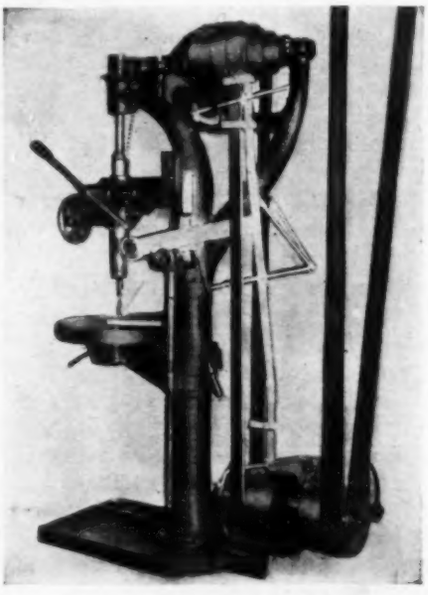
Bolt dieheads are now available from The Borden Company, Warren, Ohio, for the No. 3 "Beaver" ratchet die stock, which has cutting capacities from $\frac{1}{8}$ to 1 in. This bolt diehead will thread bolts and rods in all sizes from $\frac{1}{8}$ to 1 in., inclusive.



Bolt Diehead for "Beaver" No. 3 Ratchet Die Stock

"U.S." Cone Belt Shifter

A cone belt shifter affording positive shifting of the belt from one step to another on the cones of drilling machines, and permitting easy shifting by the operator from the front of the machine, has been placed on the market by the United States Tool & Machine Works, 27 Thames St., New York, N. Y. As shown in the accompanying illustration, this device has two pairs of brackets at each end of a long vertical bent rod. These brackets encircle the belt and force it to move from one step to another. Another bracket is placed at the top



"U.S." Cone Belt Shifter, which affords easy changing of drill speeds from the operator's position

of the cone pulley bracket of the machine and guides the vertical rod during shifting. A similar bracket is placed at the cone pulley bracket at the base. The shifting lever projects out to the front of the machine near the drill spindle and is fitted with a handle. When the handle is pulled forward or pushed away from the operator the belt is constrained to move from one step of the cone to another without jumping or hesitation. By its use an operator is more likely to select the best speed suitable for the drill being employed, and both the quality of work and time in which it is done are improved. The apparatus is built in three standard sizes.

Paulus Welding and Cutting Torches

Oxy-acetylene cutting and welding equipment, as introduced by Jos. C. Paulus & Company, 2507 Potter St., Philadelphia, Pa., from Germany, is claimed to be non-back-firing and to produce a cutting flame with the least consumption of both oxygen and acetylene. The latter is effected by the consruction of the gas expansion chamber, which is at a safe distance from the nozzles and allows each gas to expand thoroughly and unite before reaching the cutting or welding nozzles.

The cutting nozzles are made in two parts, fastened separately into the cutting head, one inside the other. A round pre-heating flame is thus produced, and oxygen for cutting passes directly through the center of the flame. The pre-heating nozzle can be unscrewed for cleaning when necessary, whereas the cutting nozzle can be cleaned in place or removed as desired.

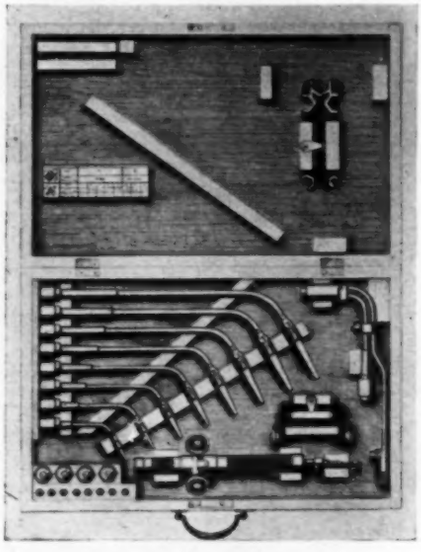


Fig. 1—Paulus Welding and Cutting Outfit

The complete welding and cutting outfit shown in Fig. 1 is for welding from $\frac{1}{32}$ up to $1\frac{1}{4}$ in., and cutting from $\frac{1}{8}$ up to 12 in. The net weight of the outfit including the box is 12 lb.

Fig. 2 shows a cutting head fastened to a universal shaft for straight or bevel cutting, together with four heating and eight cutting nozzles. Fig. 3 illustrates a welding head attached to a universal shaft ready for welding. Incidentally, tips are not changed for welding different thicknesses, but the entire head is changed so that more oxygen and acetylene may be mixed thoroughly to allow a larger flame. In Fig. 4 is shown a hole piercing head fastened to the universal shaft for cutting round holes from $\frac{9}{16}$ to 3 in. in diameter in metal from $\frac{1}{32}$ to 1 in. in thickness. A boiler tube cutting head is shown in Fig. 5, and is fastened to the universal shaft for cutting boiler tubes from $1\frac{1}{4}$ in. up from the inside. Cutting out rivet heads without damage to the plate may be effected by the head shown in Fig. 6, which is also fastened to the universal shaft, and which may be used for burning out countersunk rivets. Fig. 7 shows a brazing head fastened to a universal shaft. The small holes at the top of the tip allow air to enter and thus prevent overheating.

All of these torches are light in weight to afford convenient use.

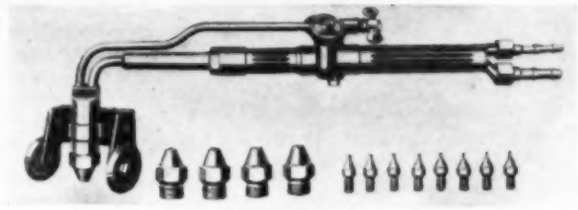


Fig. 2—Bevel cutting torch

Fig. 3—Welding head attached to shaft

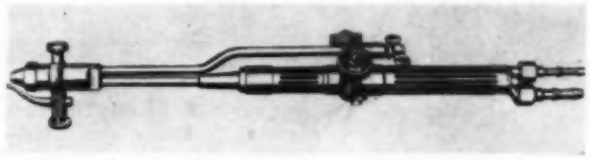


Fig. 4—Hole piercing head for holes to 3 in.

Fig. 5—Boiler tube cutting head

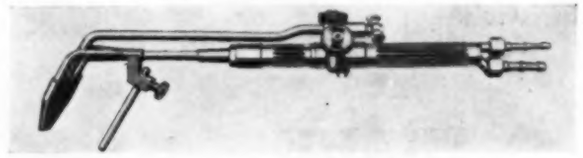


Fig. 6—Rivet cutting head

Fig. 7—Brazing head attached to shaft

Roller-Smith Type HTD Headlight Tester

A Type HTD headlight tester is being produced by the Roller-Smith Company, 233 Broadway, New York. The tester consists of a rugged d'Arsonval mechanism enclosed in a heavy sheet metal case with black enamel finish. The 2.1-in. scale is read through a narrow sector shaped opening with extra heavy glass. Terminals consist of 3-ft. rubber-covered cables fitted with insulated test clips.

In the single-range instrument, both cables are permanently attached. With double range, one cable can be attached to either of two threaded plug sockets, no push buttons being used. Dimensions are 4½ x 3 x 1½ in.

Roller-Smith Type HTD
Headlight Tester

Average net weight is 2 lb. Two sizes are available, the first with a range of from 0 to 50 volts and a double-range size with ranges of from 0 to 50 and from 0 to 500 volts.

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TRADE PUBLICATIONS

BORING BARS AND REAMERS. The Gisholt Machine Co., Madison, Wis., has issued, as of September 1930, a bulletin on its boring bars and reamers for turret lathes, engine lathes, boring mills, chucking machines, screw machines, drill presses and various types of automatic lathes. Specifications and prices are listed, and standard parts are shown.

CHANGES IN CUSTOMS ADMINISTRATIVE PROVISIONS. The Merchants' Association of New York has issued a booklet "Changes in Customs Administrative Provisions under the 1930 Tariff Act" with the aim of assisting manufacturers, importers, and exporters to avoid mistakes in procedure under the new tariff act.

FINISHES. The Norfolk Paint & Varnish Co., Norfolk Downs, Mass., has issued a catalog entitled "Norfolk Industrial, Technical, and Architectural Finishes" which describes in its 26 pages the Norfolk finishes for various classes of work.

INDUSTRIAL ADVANTAGES OF MASSACHUSETTS. The Massachusetts Industrial Commission, Room 482, State House, Boston, Mass., has prepared a folder entitled "Massachusetts, It's Industrial, Agricultural, Recreational and Economic Resources," giving typical views of industries of the state, together with a map showing cities and small towns, principal highways, airports, steamship lines, and railroads.

INDUSTRIAL OVENS. The Gehnrich Oven Co., Inc., Long Island City, N. Y., has brought out a large loose-leaf binder containing several bulletions on its industrial ovens of the gas and electric types for japanning, enameling, and lacquering operations, and also showing truck-type and car-type ovens and foundry ovens.

INSPECTED APPLIANCES. The National Board of Fire Underwriters, Chicago, Ill., has issued a "List of Inspected Gas, Oil and Miscellaneous Appliances" issued as of July 1930 on items approved by the Underwriters' Laboratories.

MOTORS AND GRINDERS. The Titan Electric Co., Adrian, Mich., has published a folder on its electric motors, generators, grinders, and buffers, known as Catalog No. 19. Descriptions, illustrations, and prices are included.

NITRIDING ESSENTIALS. The Hevi Duty Electric Co., Milwaukee, Wis., has published bulletin No. 830 entitled "Essentials of Successful Nitriding". It also gives the equipment necessary.

POWER SQUARING SHEARS. The Niagara Machine & Tool Works, 637-697 Northland Ave., Buffalo, N. Y., has issued circular No. 371, illustrating and describing several types and sizes of Niagara power squaring shears. Material is also given on the "Niagara" screw adjustable back gage and the patented holddown.

STAINLESS STEELS. The American Stainless Steel Co., Commonwealth Bldg., Pittsburgh, Pa., has issued a booklet "Stainless in Industry," telling how stainless iron and steel are furnished, its possibilities, the physical properties, the range of uses, chemical properties, and corrosion resistance as compared with other materials.

TEMPERATURE CONTROL GAGES. The Harold E. Trent Co., 439-443 N. 12th St., Philadelphia, Pa., announces bulletin TB-18 on its automatic temperature control gages with extra long scales for quick readings up to 1,000 deg. F. Photographs of the instruments and views of typical installations are included.

V-BELTS. The Medart Co., Potomac & De Kalb Sts., St. Louis, Mo., is distributing a folder on the Medart V-Belt drive in standard designs and speeds. The folder gives list prices and specifications of the various sizes available, together with data on sheaves.

WELDING MACHINES. The American Electric Fusion Corporation, 2610 Diversey Ave., Chicago, Ill., has issued a catalog in color, giving the reasons for projection or multiple welding, the salient points of its machine, and the specifications.

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PATENTS

September 9, 1930

Metal-Working Machinery

Milling-Machine Unit Head. Lora E. Beaman, Fitchburg, Mass., assigned to Shaw-Crane-Putnam Machine Co., Inc. *Patent 1,775,084.*

Milling Machine. Geoffrey Joseph Abbott, London, England, assigned to P. I. V. Chain Gears Ltd., London, England. *Patent 1,775,184.*

Control Means for Molding Machines. William J. Fiegel, Detroit, Mich., assigned to Bohn Aluminum & Brass Corporation. *Patent 1,775,239.*

Metal-Perforating Machine. George P. Thomas, Glenshaw, Pa. *Patent 1,775,359.*

Angle-Shearing Machine. Joseph A. Burger, Hartville, Ohio. *Patent 1,775,448.*

Tools and Attachments

Change-Speed Friction Drive. Richard S. Jacobsen, Wheaton, Ill., assigned to J. F. S. Co. *Patent 1,775,201.*

Reamer. Gerard A. De Vlieg, Rockford, Ill. *Patent 1,775,120.*

Emery - Wheel Dresser. Samuel Fryckberg, Port Washington, Wis., assigned to Simplicity Manufacturing Co. *Patent 1,775,124.*

Spring Hammer. Russel C. Bowen, Seattle, Wash., assigned to George R. Kollock. *Patent 1,775,188.*

Cylinder-Grinding Tool. Frederick G. Wacker and Herman W. Zimmerman, Chicago, Ill., assigned to Automotive Maintenance Machinery Co. *Patent 1,775,230.*

Reversible Close-Quarter Drill. Reinhold A. Norling, Aurora, Ill., assigned to Independent Pneumatic Tool Co. *Patent 1,775,406.*

Power-Operated Chuck. Charles P. Harrison, Wesleyville, Pa. *Patent 1,775,592.*

Furnaces

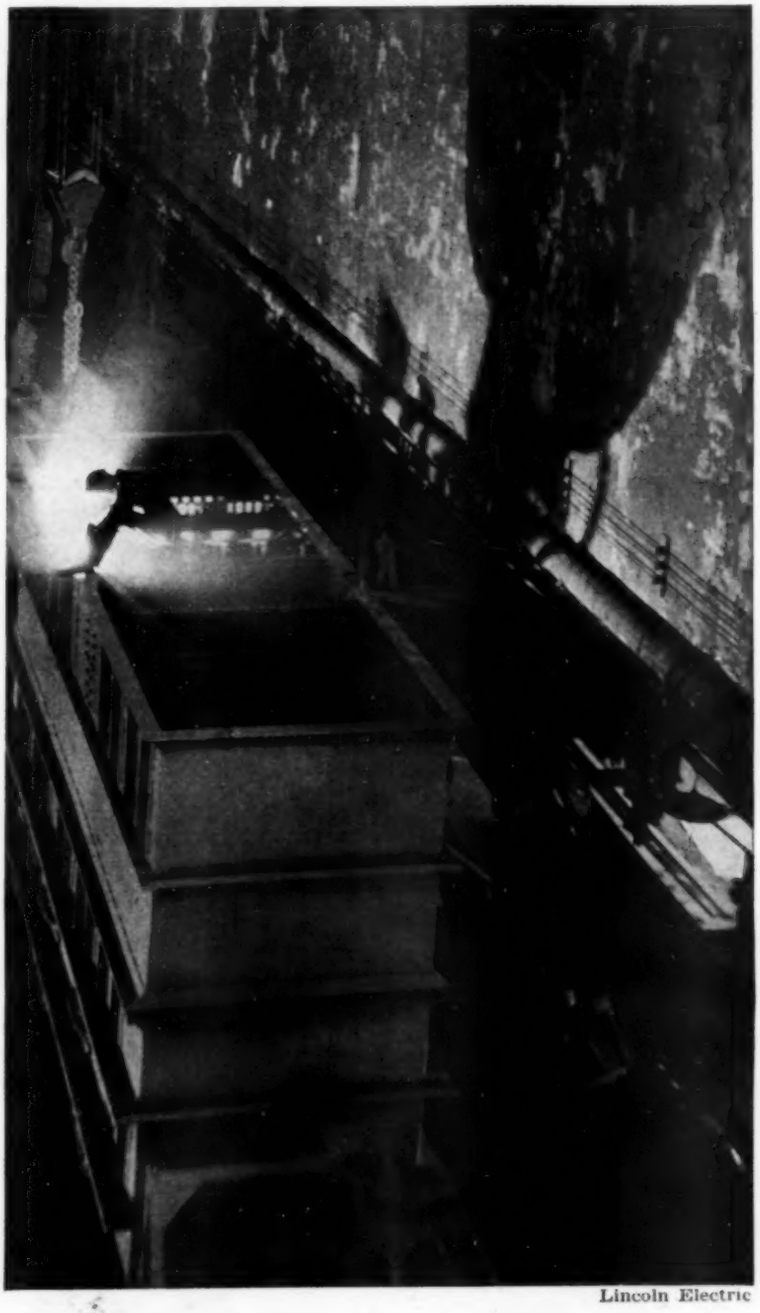
Furnace Lining. George David Evans, Baltimore, Md., assigned to American Smelting & Refining Co. *Patent 1,775,161.*

Induction Furnace. Franz Linnhoff, Eberswalde, Germany, assigned to Ajax Electrothermic Corporation. *Patent 1,775,351.*

Furnace-Wall Structure. Frank J. Tone, Niagara Falls, N. Y., assigned to The Carborundum Co. *Patent 1,775,414.*

NEWS OF THE WEEK

Annual National Metal Congress Convenes Next Week in Chicago



Lincoln Electric

LIGHT AND SHADOW

Arc-welding a pasteurizer "shell" at the plant of the Loew Manufacturing Company, Cleveland.

THE National Metal Congress convenes next week in Chicago, with some 35 technical sessions on its program at which 93 papers will be presented. More than 175 exhibitors will occupy space in the 80,000 sq.ft. comprising the accompanying Exposition at the Stevens Hotel. All meetings, except those of the American Welding Society, will be held at the Stevens, thus centering all activities conveniently. Several program innovations have been made, among them a change in the hours of the Exposition in order to allow a greater amount of free time to exhibitors and visitors, and yet to permit them to attend the technical sessions and devote an adequate amount of time to the Exposition.

It is hoped that every one of the 75,000 visitors expected will find an opportunity to call at Booth 15F, headquarters of *American Machinist* and *Product Engineering*.

A.S.M.E. Issues Program For French Lick Meeting

Technical sessions of particular interest to those in the automotive, management, materials-handling, air-conditioning, and process industries are included in the program of technical sessions for the French Lick Meeting of the A.S.M.E., from Oct. 13-15. The Automotive Session will be held on Monday morning, Oct. 13, with two papers being presented, "Engineering Problems of Modern Motor Cars," by William G. Wall, and "The Diesel Engine for Automobiles," by C. L. Cummins.

A student branch session will be held that afternoon at which a number of papers prepared by research laboratories of nearby universities will be presented. A Manufacturing Session will be held on Tuesday morning at which three papers will be presented: "Interesting Developments in the Conveyor Field," by Henry R. Gotthardt, "Psychometry and Some Common Effects of Air Conditioning on Materials," by D. C. Lindsay, and "Machine Tool Milestones—Past and Future," by Sol Einstein. In addition to this technical program a number of entertainment features, including bus trips to nearby points of interest, has been arranged. An informal dinner, at which William A. Hanley will present a paper, will be held Monday, and a banquet on Tuesday.

U. S. Tractor Exports Set Half-Year Record

Registering an increase of $11,000,000 over those of the corresponding period of last year, U. S. tractor exports reached a new high mark during the first half of 1930, according to the Agricultural Implements Divisions, U. S. Department of Commerce. Shipments during the current year amounted to 35,790 tractors with a value of $40,537,650, as compared with 34,666 units valued at $32,996,220 in the first six months of 1929. With the value of engines, parts, and accessories added, there is an even greater advantage in favor of 1930 exports, which reached the record total of $49,852,449, as compared with $38,995,228 in the first half of 1929. Exports to Russia, the leading market, reached the unprecedented total of $21,715,867 not including parts, which amounted to more than $3,000,000, as compared with $4,300,000 worth of tractors during the first half of 1929.

Survey Report Available From Tariff Commission

The United States Tariff Commission has a stock of printed surveys and reports available for free distribution from its office in Washington. These deal with a variety of industries, outlining the more important economic facts with respect to production, imports, exports, competitive conditions, and tariff problems over a considerable period of time. About 130 products or groups of products in the Metals Schedule of the dutiable list and 35 from the free list of the Tariff Act are covered. A list of the reports may be obtained by addressing the Secretary of the United States Tariff Commission, Washington, D. C.

Electrical Manufacturers Approve Standards

A number of new standards on generators, motors, and switchgear were approved by the Standards Committee of the National Electrical Manufacturers' Association at a meeting held recently in New York. These rules and revisions will be published in the near future. Some of the standards approved are those on engine-driven alternators, planer-type motors, elevator motors, motor generators, drip-proof and fully protected motors, crane motors, oil circuit breakers, switching equipment, transformer impedance, and attachment plugs.

Class I Railroads Report Decreased Income

Class I railroads of the United States for the first seven months this year had a net railway operating income of $458,943,343, which was at the annual rate of return of 3.64 per cent on their property investment, according to reports just filed by the carriers with the Bureau of Railway Economics. For seven months of 1929 their net railway operating income was $686,391,088, or 5.56 per cent on their property investment. Gross operating revenues for the first seven months of 1930 totaled $3,148,700,980, as compared with $3,626,465,518 for the same period of last year, or a decrease of 13.2 per cent. Operating expenses for the first seven months of 1930 amounted to $2,405,088,119, as compared with $2,638,986,808 for the same period one year ago.

BUSINESS ITEMS

Kay-Brunner Steel Products, Inc., 999 Meridian St., Alhambra, Calif., has recently completed its new Alhambra plant. The Los Angeles plant has been discontinued and consolidated at the Alhambra location. The steel casting floor at the new plant is 600 ft. long and 120 ft. wide.

The Massey-Harris Co., Ltd., Toronto, Ont., is negotiating a merger of its Australian subsidiary with H. V. McKay Proprietary, Ltd. The Canadian business of H. V. McKay Proprietary, Ltd., is not affected by the transaction.

The American Engineering Co., Philadelphia, Pa., has appointed the following distributing agents for Lo-Hed Electric Hoists: Starr-Carpenter, Park Bldg., Pittsburgh, for the Pittsburgh district; and Weed & Co., 95 Swan St., Buffalo, N. Y., for the Buffalo district.

The Foote Bros. Gear & Machine Co., 111 N. Canal St., Chicago, Ill., has recently appointed the J. L. Hart Machinery Co., S. Florida and Eunice Aves., Tampa, Fla., as representative of the company in the state of Florida, south of a line drawn east and west across the state from Centralia to Titusville.

The Rawson Brake & Equipment Co., now operating a manufacturing plant in Detroit, will move to Elizabeth, N. J., on Oct. 1 to occupy part of the Durant plant recently taken over by Bayway Terminal, Inc. The Rawson concern has leased 10,000 sq.ft. of space.

The Granite City (Ill.) Steel Co. has appointed Ambler & Garnjost, San Francisco and Los Angeles, district sales agents for the Pacific Coast. A. B. Ambler, 444 Market St., San Francisco, is senior partner. A. E. Garnjost, San Fernando Bldg., Los Angeles, is junior partner.

The Pratt & Whitney Co., Hartford, Conn., is holding a 70th anniversary reunion and banquet on Wednesday, Oct. 1. Invitations have been sent out for a plant inspection from 1 to 5 p.m. and a banquet at 6:30 p.m.

The St. John X-Ray Service Corporation, 505 Fifth Ave., New York City, has moved its laboratory to the Eveready Bldg., 30-20 Thomson Ave., Long Island City, N. Y. The new quarters permit x-ray inspection of any object weighing up to 5 tons.

The Welded Products Corporation, Kansas City, Mo., recently purchased an 11-acre industrial site in a district east of the present location.

PERSONALS

H. F. De Lacour, purchasing agent and traffic manager with The Bullard Co. for 11 years, has joined the Vanadium Alloy Steel Co., Latrobe, Pa. Mr. De Lacour will be a member of the sales force and will be located first at the Latrobe office.

Sidney Dillon, chief mechanical engineer of the Carnegie Steel Co., has been named assistant to the vice-president.

C. T. Connelly, formerly of the Detroit office of the Independent Pneumatic Tool Co., Chicago, has been appointed Buffalo office manager.

ROBERT SERGESON

M. M. CLARK

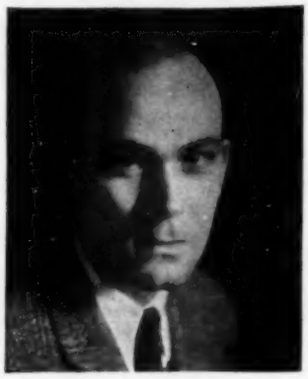
Co-authors of a paper entitled, "Nitriding Analyses—Their Physical Properties and Adaptability" to be presented before the A.S.M.E. on Sept. 24

O. J. Frisken, until recently heating engineer with the Crane Co. of Canada, Toronto, Ont., has joined the staff of Babcock-Wilcox & Goldie-McCulloch, Ltd., at Galt, Ont.

E. Longden, who recently completed the modernization of the foundries of John Hetherington & Co., Ltd., Manchester, England, is visiting representative American foundries at the present time.

R. Stuart Murray has been appointed an associate on the staff of Black & Bigelow, Inc., 551 Fifth Ave., New York City, to act in an advisory capacity on South American aeronautical projects and activities.

Ray P. Tarbell has recently become a member of the firm of Robert E. Kinkead, Inc., consulting welding engi-



neers, Cleveland, Ohio. He was formerly Cleveland district sales manager of the Lincoln Electric Co., Cleveland.

L. A. Peto, vice-president of the Canadian Car & Foundry Co., has sailed for The Hague to be present at the special meeting of the Mixed Claims Committee from the United States.

Lewis E. Skinner, manager of the Cincinnati plant of Joseph T. Ryerson & Son, Inc., Chicago, will celebrate his 25th anniversary with the company today, Sept. 18.

Griswold Van Dyke, general manager of the special steel department of Joseph T. Ryerson & Son, Inc., Chicago, Ill., presided at a meeting to discuss various types of stainless steels and a demonstration of advanced methods of fabricating and welding these alloys, at the Front & Freeman plant of the company in Cincinnati, on Sept. 11.

J. A. Weiger, chairman of Technical Committee No. 14 of the A.S.M.E. on Electric Welding Dies and Electrode Holders, has called a meeting of the committee for Sept. 25, at the Congress Hotel in Chicago, Room 1102.

W. H. Wills, metallurgist of the Ludlum Steel Co., Dunkirk, N. Y., spoke on the subject, "Tool Steel Applications," at this season's first monthly meeting of the New Jersey chapter of the American Society for Steel Treating, Sept. 4.

F. H. Willco, vice-president of the Freyn Engineering Co., Chicago, will give a dinner address on "Development of the Iron and Steel and Secondary Manufacturing Industries in Soviet Russia" at the joint dinner of the National Meeting of the Iron & Steel and Machine Shop Practice Divisions of the A.S.M.E. in Chicago, Sept. 24-26.

Guy Hubbard, formerly advertising manager of the National Acme Co., Cleveland, Ohio, has become an associate editor of "Steel," the Penton publication known until recently as the "Iron Trade Review."

OBITUARIES

Robert Strauss, 58, master mechanic of the Youngstown (Ohio) Sheet & Tube Co., died recently of injuries he received in an automobile accident.

George E. Warren, mechanical engineer in charge of the experimental department of the United Shoe Machinery Corporation, Beverly, Mass., died on Sept. 2 at Brookfield, N. H.

Frank E. VanDoorn, 59, treasurer of the VanDoorn Co., Quincy, Ill., died Sept. 5 in his home after several months illness. He located in Quincy 36 years ago, launching the plating and brass foundry which bears his name.

Warren J. J. Derwent, mechanical engineer of Schenectady, N. Y., formerly engineer with the Certainteed Products Corporation, died on July 19.

Thurston W. Ludlow, 72, president and treasurer of the Springfield (Ohio) Malleable Iron Co., died recently at his home there.

Carl B. Stewart, 36, assistant general auditor of the National Electric Power Co., New York, died Sept. 1 at his home in that city.

Walter F. Goodrich, consulting mechanical engineer, died in London, England, on July 21.

J. W. Stewart, manager of the Columbiana (Ohio) Pump Co., died recently at his home in that city.

FORTHCOMING MEETINGS

NATIONAL METAL CONGRESS—Twelfth annual Congress and Exposition, Stevens Hotel, Chicago, Sept. 22-26. W. H. Eisenman, secretary of the A.S.S.T., 7016 Euclid Ave., Cleveland, Ohio, is director.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Calvin W. Rice, executive secretary, Engineering Societies Bldg., 29 West 39th St., New York, N. Y. The following meetings are scheduled:

Iron & Steel and Machine Shop Practice Divisions, annual fall meetings, Stevens Hotel, Chicago, Sept. 22-26. Address P. T. Wetter at above address.

French Lick Meeting, French Lick Springs Hotel, French Lick, Ind., Oct. 13-15.

Fifty-first annual meeting, Engineering Societies Bldg., Dec. 6.

AMERICAN INSTITUTE OF MINING & METALLURGICAL ENGINEERS — Annual fall meeting of Iron & Steel and Institute of Metals Divisions, Stevens Hotel, Chicago, Sept. 22-26. T. T. Read, Engineering Societies Bldg., 29 West 39th St., New York City, is secretary.

AMERICAN WELDING SOCIETY—Annual fall meeting, Congress Hotel, Chicago, September 22-26. W. M. Spraragen, 29 W. 39th St., New York, N. Y.

AMERICAN SOCIETY FOR STEEL TREATING—Annual Convention, Stevens Hotel, Chicago, September 22-26. W. H. Eisenman, 7016 Euclid Ave., Cleveland.

NATIONAL SAFETY CONGRESS—Nineteenth Annual, to be held at Fort Pitt and William Penn Hotels, Pittsburgh, from Sept. 29 to Oct. 3. Metals Section meetings will be held on Tuesday and Wednesday mornings and Thursday afternoon.

AMERICAN GEAR MANUFACTURERS' ASSOCIATION — Semi-Annual meeting, Hotel Clifton, Niagara Falls, Ont., Canada, from Sept. 29 to Oct. 1.

SOCIETY OF AUTOMOTIVE ENGINEERS — Production meeting, Hotel Book-Cadillac, Detroit, Oct. 7-8. R. S. Burnett, director, production activities, 29 West 39th St., New York City.

GRAY IRON INSTITUTE, INC. — Third Annual Convention at Hotel Cleveland, Cleveland, Ohio, October 8. Arthur J. Tuscany, Terminal Tower Bldg., Cleveland, is manager.

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION—Cost Conference, Hotel Clifton, Niagara Falls, Ont., Canada, Sept. 22-23. Ernest F. DuBrul, 1415 Enquirer Bldg., 617 Vine St., Cincinnati, Ohio, is general manager.

NATIONAL MACHINE TOOL BUILDERS' ASSOCIATION—29th Annual Convention, Hotel Aspinwall, Lenox, Mass., October 13-15. Ernest F. DuBrul, 1415 Enquirer Bldg., 617 Vine St., Cincinnati, Ohio, is general manager.

SOCIETY OF INDUSTRIAL ENGINEERS—17th National Convention, Mayflower Hotel, Washington, D. C., Oct. 15-17. George C. Dent, 1815 Engineering Bldg., 205 W. Wacker Drive, Chicago, executive secretary.

STEEL FOUNDERS' SOCIETY OF AMERICA—October meeting at Pennsylvania Hotel, New York City, on Oct. 23, the day preceding the New York meeting of the American Iron & Steel Institute. G. P. Rogers, 932 Graybar Bld., New York City, is managing director.

NINTH NATIONAL EXPOSITION OF POWER AND MECHANICAL ENGINEERING —In Grand Central Palace, New York City, Dec. 1-6.

WESTERN METAL CONGRESS AND EXPOSITION—Second National, Civic Auditorium, San Francisco, Calif., Feb. 16-20, 1931. Under auspices of A.S.S.T. W. H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

THE INDUSTRIAL REVIEW

Weekly progress of the machinery and machine-tool business

THE following reports, gathered from the various machinery and machine-tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

NEW ENGLAND

It is generally expressed that the month of August showed a spotty but sure improvement in the volume of machine-tool orders placed. The trend for improvement has been slow and tedious and is likely to continue so. Large manufacturers of machine tools have built for stock and a large volume of business is needed to produce full-time schedules.

Recent improvement has been noted in working schedules in the radio and electrical industries. A Providence manufacturer of radio tubes has added 200 men to meet Fall demands.

CINCINNATI

A few of the machine-tool manufacturers of the Cincinnati district had some increase in sales during the past week. Selling agents feel that prospects are nearer to the placing of orders, and for this reason a better market is developing.

A feature of the week's business was an order for eleven lathes, placed by a Western construction company. Besides this, manufacturer received several smaller orders. In the main, orders booked were from general users whose requirements were single tools for replacements. Sales were well diversified.

Inquiries came in freely from miscellaneous users, located in all sections of the country. A few manufacturers have increased production slightly, but as a whole, the volume of output has undergone no material change.

NEW YORK

If bulldog tactics and Cheshire cat optimism are the requisites for success in sales activities, New York machinery and machine-tool dealers should be reaping their rewards any day now. Even though sales bear the same relation to expenses that a bantam Austin does to a motorbus, dealers grit their teeth and hold on. Results are beginning to be manifest in increasing numbers of inquiries. Although none of them are of a size large enough to create any cause for celebration, they seem at least to be a little better founded than some in the past.

Rumors are rife regarding the remainder of the American Locomotive inquiry for Schenectady, opinions regarding time of placing orders varying from a week or two to next year. When something like $200,000 is concerned, however, there is likely to be considerable speculation. Rumor has it also that Ford has given Bullard a $250,000 order, although this could not be confirmed at the time of going to press. The Reading Co. recently awarded a contract for 30,000 tons of rails to Bethlehem, at a cost of something over a million. Westinghouse has a Government order for $500,000 worth of battleship turbines, and Babson says there'll be a stampede of orders and a congestion of freight, so some dealers even feel a little like trying to whistle once more.

BUFFALO

The expected upturn in the machine-tool business in early September has not materialized during the first two weeks of the month. Most dealers are unable to note any improvement, and one of the most optimistic ones says that one of the inquiries indicate immediate action, although there are a few more than usual.

A slight amount of the business of the Mackintosh-Seymour Corporation, Auburn, came to Buffalo, but most of this was placed in Syracuse and elsewhere.

A considerable amount of equipment will be used in the new Ford plant here.

Electrical supply dealers are in about the same position as the machine-tool dealers. Dealers in contractors' equipment had a good business until the middle of the summer, but this has fallen off badly in recent weeks. Contractors who are going to build about $2,000,000 worth of new schools in Buffalo during the next few months, are inclined to get along with what they have for the present.

POLLYANNISTIC prognosticators, embarrassed two weeks ago by a further business gyration, are struggling bravely onward again. As little believed as any prophets, the band of the faithful is, however, steadily being augmented. Now that summer is waning, the pulmotor brigade is really getting in some heavy pulling, effective enough so that the machine-tool industry is a little dazed at beholding itself actually pulling itself up by its own bootstraps. And the wave of optimism seems well founded, even though prospects have been hanging onto their nickels so long that the Indian is riding the buffalo.

LAST WEEK showed a few more inquiries and a few more orders, the inquiries being generally of a tone that indicates buying. New York, usually the country's leader, is bashfully hanging back, still dominated by one short street near the Battery. Orders include one for a million dollars worth of rails, another for $500,000 worth of battleship turbines. New England, though expressing the characteristics of the ultra-lethargic Lightnin', is showing increasing interest in Amos 'n' Andy and the radio crooners. Cincinnati tells of an order for 11 lathes and of several lengthened working schedules. Canadian manufacturers of heavy tools are leading the way back to normalcy, supported by increasing automotive output and a good volume of electrical business. Indianapolis is feeling better, too.

CHICAGO, preparing to greet 75,000 visitors to the National Metal Congress, exhibits signs of improvement and has received some inquiries from sources that have been quiet for a long time. Buffalo is "feelin' poorly," in sympathy with New York, but the future is bright.

INDIANAPOLIS

While there are no important lists out in this area, there are individual sales being made that have given some encouragement to the machinery and machine-tool trade. Inquiries also are coming in for replacements. A survey of the state's employment situation shows more men put to work during August than for the past six months.

In view of the fact that the railroads have purchased so sparingly during the last eight months, the local trade is expecting some buying from this quarter during the fall and early winter. Already some few inquiries are being received that should presage more business.

At the present time some sales are being made in coal mining machinery. Most of the sales are for special equipment. An improvement is seen in the iron and steel business. The improvement is not great, but some purchases have been made and there are inquiries. One tube factory in the northern part of the state reports it has enough orders for pipe to keep the plant—and it is a large one—in operation steadily for the next five months.

CHICAGO

While business in machine tools continues at a low level, generally speaking, there are undoubted signs that an improvement is starting. This is evidenced by an increasing number of inquiries, some of them from sources that have shown no interest for several months. In addition, there has been some closing on inquiries long pending. One concern reports an order for three of its largest units built to specification. In the used-tool market there have also been evidences of a pick-up in trade, a number of good sales being reported by one of the leading dealers. The Illinois Steel Co., which within the last two months has issued lists asking for prices on several items needed for its South Chicago plant, this week is asking for figures on a 20-in. cold metal saw. Inquiries from other industrial sources include a number of single tools. Machinery men say it is premature to predict an immediate upward curve on the machine-tool chart, but they express more optimism.

CANADA

Demand for machinery and machine tools throughout Canada is gradually increasing and leaders in the industry exhibit a more cheerful frame of mind as it becomes more and more evident that a general revival of trade and industry is in sight. Manufacturers of heavy tools report a marked improvement in sales during August and there has been a comparatively good market for used tools. The iron and steel industry is gradually gaining momentum, car-building plants are still working at near capacity, and agricultural implement sales are improving. The automotive industry picked up slightly during August, but output is still far below this time last year. The industry dropped sharply in June and July to a new low for this year of 48.2 per cent below normal. With the assistance of several major engineering awards, construction started during August exceeded that for July by 32.2 per cent. William Kennedy & Sons, Ltd., have received an order for 52 Kennedy Falk herringbone-gear speed-reducer units and flexible couplings for the new 6,900,000-bushel grain elevator at Fort William, Ont. The electrical and allied manufacturers are enjoying a good volume of business.

BUSINESS • BAROMETER

National conditions seem generally to indicate an upturn, and only a few disquieting symptoms remain

THEODORE H. PRICE
Editor, Commerce and Finance, New York

THE calm before the storm is frequently remarked upon, although little is heard of the calm that nearly always succeeds the storm. The fatigue of those who have been fighting the elements probably explains the disposition to ignore the tranquillity that follows a tempest, but it is not, for that reason, any less important than the quietude which is supposed to precede the gale.

Just now the United States is enjoying this quietude. It makes people restive, but they are accumulating a supply of energy that can be drawn upon during the next period of activity, and that period seems to be approaching with as much rapidity as could be expected. The most unfavorable feature in the situation is the alleged unemployment. The trade unions are exploiting this feature for all it is worth, and the newspapers are giving prominence to what one of them describes as "The pursuit of jobs by the jobless." That many men and women are out of work at present is undoubtedly true, but authoritative information upon the subject is exceedingly difficult to obtain. That a number of skilled workers are idle seems to be undeniable, but some large employers of labor insist that many unskilled workers are unemployed because they cannot find the sort of work they prefer.

Meantime, the Government and many large corporations are getting ready to start improvements or construction that will require the labor of a great number of men, and the charity organizations of the country are preparing to take care of any who may be in want during the coming winter.

Trade is also commencing to pick up. Car loadings are still behind last year, but they are gaining rapidly, and a distinct revival in commercial activity appears to be approaching. The steel industry shows some improvement despite the reduction in the number of automobiles manufactured, and buyers are commencing to take an interest in several of the low-priced commodities. Continued weakness in rubber followed the announcement that the government of the Straits Settlements would refuse to cooperate in restricting production in the Far East, but there was some good buying at the decline, and the tire manufacturers are said to be increasing their holdings. Occasionally spasmodic strength has developed in the grain markets, and although new lows were made last week, many now claim that the bottom has been reached. The corn crop figures are sensationally small, and demand for wheat ought to be heavy after the world is convinced the season's lows are past.

The mail-order houses, the department stores, and nearly all of the chains reported decreased sales in August, as compared with the same month last year. Since Labor Day, however, the business of most of them has improved considerably. September is nearer to being a barometric period than August, and if business during this month continues to show an ascending tendency, the effect upon sentiment will be most salutary. The textile business is certainly improving, and the mills can sell all the standard goods they are willing to contract for at present prices. Many of the manufacturers are, however, more disposed to buy cotton than to sell goods at present levels, and despite the complaints which come from some quarters, the feeling generally is more cheerful.

The stock market has been quiet. This is natural and desirable. A boom in stocks would be premature and would scare many who are recovering their confidence. The irresistible power of cheap money is gradually making itself felt, and the Government has succeeded in selling its short-time obligations at 2⅛ per cent, which is the lowest rate on record. Sooner or later the effect must be to advance the price of other interest-bearing securities, and give tone to the whole investment situation.

The elections in Maine and the primaries held in other states during the week do not seem to indicate the political reversal that had been expected in many quarters, and if the radical or insurgent element in Congress shall not be increased as a result of the November elections, the politico-economic problem will probably be resolved to the satisfaction of those who dread change.

The one unsettling feature of the situation overseas is the political turbulence which seems to be developing in India, China, and South America. The conditions in East India and China, while perplexing, are not so serious as the scareheads would suggest, but Latin America, particularly Argentina, appears to be in a state of great excitement, and it is possible that some blood may be shed before tranquillity is reestablished. Revolutions are, however, normal in the countries that are now affected, and those who know Argentina well insist that the government recently established there will be able to cope successfully with the deposed president and the small band of supporters that have remained constant to him. In gaging the effect of these South American outbursts, it should not be forgotten that bloodless revolutions have long been a feature of political life in South America, and that the people there are probably far less disturbed by them than we are.

THE BUSINESS WEEK

September 17, 1930

THE marked lull in business activity this year at the end of August and the beginning of September has been followed by a general freshening of business sentiment as signs of seasonal improvement accumulate. Lengthened plant holidays and deferred check payments in the fortnight including Labor Day dropped our index to 83.5% of normal despite evidence that business recovery, beginning as usual with the basic industries and primary distribution, is proceeding normally in response to seasonal stimulus. Coal and electric power production are increasing, steel output is being maintained, carloadings are rising. Expansion of commercial loans and currency circulation indicate a rising volume of wholesale and retail trade as the fall buying movement gets under way. Business is beginning to feel better than it looks, but is still stymied by undue caution in making forward commitments, which is keeping working supplies of raw materials and retail stocks of finished goods below normal requirements and consumer standards. If business initiative and Federal Reserve policy will take their foot off the brake and step on the gas at this time we can turn the corner without much danger of skidding.

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THE WEEKLY PRICE GUIDE . . . .

Rise and Fall of the Market

BUYING of structural steel shows no tendency to subside, despite lack of vigorous inquiry for railway material, which is usually active at this season. Automotive buying now runs to small lots. Moreover, there is notable slowness in demand for wire products of all kinds. Black steel sheets dropped 10c. per 100 lb., Pittsburgh; both black and galvanized fell 25c. at Chicago, during the week. Copper sales continue in small volume, while demand for zinc also is light. The present market for tin is the dullest of any in the non-ferrous group. Lead buying, on the other hand, shows notable steadiness. All in all, the dealers look for no improvement in warehouse business before next quarter.

(*All prices as of September* 12, 1930)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern (silicon 1.75@2.25)	$16.69@$18.19
Northern Basic	19.89@ 20.39
Southern Ohio No. 2	19.89@ 20.39
NEW YORK—Tidewater Delivery	
No. 2 Southern (silicon 1.75@2.25)	18.00@ 18.50
BIRMINGHAM	
No. 2 Foundry (silicon 1.75@2.25)	14.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	20.00
Virginia No. 2	18.75@ 19.25
Basic	22.29
CHICAGO	
No. 2 Foundry, local (silicon 1.75@2.25)	19.00
No. 2 Foundry, Southern (silicon 1.75@2.25)	18.20
PITTSBURGH, including freight charge ($1.76) from Valley:	
No. 2 Foundry	19.63@ 20.13
Basic	19.63@ 20.13
Bessemer	20.76

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.50
Cleveland	4.75
Cincinnati	4.45
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots:

Blue Annealed*	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	1.90@2.00	3.35†	3.00	3.40†
No. 12	1.95@2.05	3.45†	3.10	3.45†
No. 14	2.05@2.15	3.55†	3.20	3.50†
No. 16	2.15@2.25	3.65†	3.30	3.60†
Black				
Nos. 18 to 20	2.15@2.25	3.60†	3.40	3.70
No. 22	2.30@2.40	3.75†	3.55	3.85
No. 24	2.35@2.45	3.80†	3.60	3.90
No. 26	2.45@2.55	3.90†	3.70	4.00
No. 28	2.60@2.70	4.05†	3.85	4.15
Galvanized				
No. 10	2.30@2.40	3.65†	3.65	3.55
Nos. 12 to 14	2.40@2.50	3.75†	3.75	3.65
No. 16	2.50@2.60	3.85†	3.85	3.75
No. 18	2.65@2.75	4.00†	4.00	3.90
No. 20	2.80@2.90	4.15†	4.15	4.05
No. 22	2.85@2.95	4.20†	4.20	4.10
No. 24	3.00@3.10	4.35†	4.35	4.25
No. 26	3.25@3.35	4.60†	4.60	4.50
No. 28	3.50@3.60	4.85†	4.85	4.75

*Light Plates. †400 to 3,999 lb.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. butt	56.14%	43.6%	53.3%	42.3%	57.3%	44.8%
3½ to 6 in. lap	52.72%	40.18%	50.8%	37.8%	53.9%	41.4%

WROUGHT-STEEL PIPE LIST

Size, Inches	List Price per Foot	Diameter in Inches—External	Diameter in Inches—Internal	Thickness Inches
⅛	$0.17	1.315	1.049	.133
¼	.23	1.66	1.38	.14
⅜	.27½	1.9	1.61	.145
½	.37	2.375	2.067	.154
¾	.58½	2.875	2.469	.203
1	.76½	3.5	3.068	.216
1¼	.92	4.0	3.548	.226
1½	1.09	4.5	4.026	.237
2	1.48	5.563	5.047	.258
2½	1.92	6.625	6.065	.28
3	2.50	8.625	8.071	.277

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb.:

Thickness—Decimal	B.w.g. and Fractions	Outside Diameter in Inches—⅛	¼	⅜	½	1	1¼	1½ (Price per Foot)
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb.:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	7.00	6.00	6.15
Hoop steel	3.75†	4.00	3.75†
Cold rolled strip steel	4.95	6.00	6.10
Floor plates	4.85†	5.30	5.00†
Cold fin., round or hexagon‡	3.40	3.65	3.35
Cold fin,, flat or square‡	3.90	4.15	3.85
Structural shapes	3.10†	3.00	3.00†
Soft steel bars	3.10†	3.00	3.00†
Soft steel bar shapes	3.10†	3.00	3.00†
Soft steel bands	3.40†	3.65	3.20†
Tank plates	3.10†	3.00	3.00†
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, $\frac{3}{16}$-in. thick by ¾-in. wide. †400 to 3,999 lb., ordered and released for shipment at one time. ‡Cold finished steel, shafting and screw stock.

Electric welding wire at New York warehouse—$\frac{3}{32}$, 8.35c. per lb.; ⅛, 7.85c. per lb.; $\frac{5}{32}$ to ½, 7.35c. per lb.

METALS

Warehouse Delivery Prices in Cents Per Lb. for Small Lots:

Copper, electrolytic, New York			12.50
Tin, Straits, pigs, New York			32.50@33.50
Lead, pigs, E. St. Louis	5.35	New York	6.50@ 7.00
Zinc, slabs, E. St. Louis	4.30	New York	6.25@ 7.25

	New York	Cleveland	Chicago
Antimony, slabs	10.00@10.50	11.00	10.75
Copper sheets*	20.75	20.75	20.75
Copper wire*	13.00	13.12½	13.12½
Copper, drawn, round*	19.25	19.25	19.25
Copper tubing*	23.00	23.00	23.00
Brass sheets, high*	17.87½	17.87½	17.87½
Brass tubing, high*	22.75	22.75	22.75
Brass rods, high*	16.12½	16.12½	16.12½
Brass wire, high*	18.37½	18.37½	18.37½

*Mill, base.

SHOP MATERIALS AND SUPPLIES

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%†	23.30	24.30	23.30
Zinc sheets (casks)	9.75@10.25	11.25	10.11
Solder (½ and ½)	24.50	23.50	22@24
Babbitt metal, delivered in case lots, New York, cents per lb.:			
Genuine, highest grade			50.00
Commercial genuine, intermediate grade			37.00
Anti-friction metal, general service			31.00
No. 4 babbitt, f.o.b.			10.50

†F.O.B.

NICKEL AND MONEL METAL—Price in cents per lb., base, f.o.b. Huntington, W. Va.:

	Nickel	Monel Metal
Sheets, full finished	52.00	42.00
Sheets, cold rolled	60.00	50.00
Strip, cold rolled	55.00	45.00
Rods, hot rolled	45.00	35.00
Rods, cold drawn	50.00	40.00
Tubing	75.00*	90.00†
Angles, hot rolled	50.00	40.00
Plates	52.00	42.00

*Seamless. †Welded.

OLD METALS—Dealers' purchasing prices in cents per pound, f.o.b. cars:

	New York	Cleveland	Chicago
Crucible copper	9.00 @9.25	9.00	8.75@ 9.25
Copper, heavy, and wire	8.25 @8.50	8 75	8.00@ 8.50
Copper, light, and bottoms	7.50 @7.75	8.50	7.00@ 7.50
Heavy lead	4.25 @4.37½	4.00	3.50@ 4.00
Tea lead	2.00 @2.25	2.50	2.50@ 3.00
Brass, heavy, yellow	5.25 @5.50	5.00	5.00@ 5.50
Brass, heavy, red	7.25 @7.50	7.75	7.25@ 7.75
Brass, light	4.25 @4.50	4.00	4.50@ 5.00
No. 1 rod-brass turnings	5.37½@5.50	5.00	5.00@ 5.50
Zinc	2.00 @2.25	1.50	1.75@ 2.00

TIN PLATES—Charcoal—Bright—Per box:

"AAA" Grade:	New York	Cleveland	Chicago
IC, 14x20	$12.10	$11.95	$11.50
"A" Grade:			
IC, 14x20	9.70	9.90	9.50
Coke Plates—Primes—Per box:			
100-lb., 14x20	6.45	6.10	7.00
Terne Plates—8-lb. Coating—Small lots—Per box:			
IC, 14x20	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.	$0.13	$0.16	$0.15
Cotton waste, colored, per lb.	.09½	.12	.10
Wiping cloths, washed, white, per lb.	.13½	38.00 per M	.14½
Sal soda, per lb.	.01½	.02	.02
Roll sulphur, per lb.	.028	.03½	.04
Linseed oil, raw, in 1 to 4 bbl. lots, per lb.	.114	.141	.113
Cutting oil, about 25% lard, in 5 gal. cans, per gal.	.65	.60	.60
Machine oil, medium-bodied (55 gal. steel bbl.) per gal.	.33	.36	.24
Belting—Present discounts from list in fair quantities (½ doz. rolls) for leather or rubber:			
Leather—List price, 24c. per lin.ft., per inch of width, for single ply:			
Medium grade	30–10%	30–10%	35%
Med. grade, heavy wgt.	30%	30 –5%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft.:			
First grade	50%	50–10%	50%
Second grade	60%	60– 5%	50–10%

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars	per lb.	$0.031	$0.031	$0.033
Cold fin. shafting	per lb.	.034	.034	.036
Brass rods	per lb.	.1612½	.1612½	.2125
Solder (½ and ½)	per lb.	.245	.245	.3325
Cotton waste, white	per lb.	.13	.13	.10@.13½
Disks, aluminum oxide mineral, cloth, No. 1 6-in. dia.	per 100	4.59	4.59	3.60
Lard cutting oil	per gal.	.65	.65	.75
Machine oil	per gal.	.33	.33	.33
Belting, leather, medium	off list	30–10%	30–10%	30–10%
Machine bolts, up to 1x30 in., full kegs	off list	65%*	50–10%*	50–10%*

*List prices as of April 1, 1927

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials — Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
Flint paper*	$6.03	$6.03	$6.03
Emery cloth*	25.87	25.87	25.87
Disks, aluminum oxide mineral, 6 in. dia., No. 1, per 100:			
Paper†	2.61	2.61	2.61
Cloth†	4.59	4.59	4.59
Fire clay, per 100 lb. bag	1.00	.75	.75
Coke, prompt furnace, per net ton	Connellsville,		2.60
Coke, prompt foundry, per net ton	Connellsville,		3.50@4.85
White lead, dry	100 lb. kegs	New York,	13.75
White lead, in oil	100 lb. kegs	New York,	13.75
Red lead, dry	100 lb. kegs	New York,	13.75
Red lead, in oil	100 lb. kegs	New York,	15.25

*Less than 3 reams. †Less than 200.

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

Machine bolts:	
Up to ¾-in. x 6-in., full kegs, list less	65%
Larger, up to 1 x 30-in., full kegs, list less	65%
Less than full kegs or case lots, add to list	10%
Fitting-up bolts: list less	45%
Lag screws:	
Up to ½-in. x 6-in., list less	65%
Larger, list less	65%
Less than full keg or case lots, add to list	10%
Rivets:	
Structural, round head, full kegs, net	$4.50
Structural, round head, broken kegs, net	6.00
Tank, 7/16-in. dia. and smaller, list less	65%
Nuts:	
Hot pressed, square or hexagonal, blank or tapped:	
Full kegs up to 1-in., incl., list less	65%
Larger, up to 3-in., list less	65%
Less than keg or case lots, add to list	10%
Washers:	
Wrought, full kegs, per 100 lb., list less	$4.00
Wrought, broken kegs, per 100 lb., list less	2.00
Turnbuckles:	
With stub ends, list less	20–10%
Without stub ends, list less	55%
Chain:	
Proof coil, base, per 100 lb., net	$8.50
Cast iron welding flux, per lb., net	.35
Bronzing flux, per lb., net	.50

MACHINE REQUIREMENTS AND INDUSTRIAL CONSTRUCTION

Equipment Wanted

Ind., Anderson—Hanson Van Winkle & Munning, 1520 West Second St.—machinery and equipment for the manufacture of polishing and plating machinery for recently acquired plant.

Opportunities for Future Business

Calif., Oakland—L. DeSanno, 1853 38th Ave., plans the construction of machine shop, foundry and pattern shop on Chapman St. Estimated cost $15,000.

Ill., Chicago — Salvation Army, 717 North State St., awarded general contract for a 2 story, 100 x 107 ft. industrial home and garage at 2258 Clybourn St. Estimated cost $100,000. Noted Aug. 14.

Ind., Anderson—Hanson, Van Winkle & Munning, 1520 West Second St., acquired the plant of the Nyberg Automobile Co. and plans to completely remodel plant and install equipment. Buildings contain 3,000 ft. of floor space and owner plans to increase this to 100,000 ft. early in 1931.

Ind., Auburn—Hoff Motor Co., had plans prepared for the construction of a 2 story, 32 x 70 ft. service station and shop. Estimated cost $50,000. Private plans.

Ind., Harlan—Standard Oil Co., had plans prepared for the construction of a service station on Main St. Estimated cost $40,000. Private plans.

Iowa—Iowa State High Commission, Ames, awarded contract for the construction of two maintenance shops at Spirit Lake and Odebolt; also maintenance garages at Grinnell, Des Moines and Columbus Junction.

Mass., Malden—Malden Electric Co., J. T. Day, Mgr., 157 Pleasant St., plans the construction of a distribution station, warehouse and laboratory on Centre St. Estimated cost $50,000. Private plans.

Mich., Detroit—C. W. Brandt, Francis Palms Bldg., Archt., is receiving bids for a 1 story, 40 x 300 ft addition to aluminum parts factory on Joseph Campau Ave. for Bohn Aluminum & Brass Co., 2512 East Grand Blvd. Estimated cost $45,000. Noted July 31.

Mo., St. Louis—Bd. of Education, 911 Locust St., awarded contract for a 4 story, 101 x 150 ft. shop building. $136,913. Noted Aug. 28.

N. J., Camden—Francesco & Jacobus, 511 5th Ave., New York, N. Y., Archts. and Engrs., will receive bids late in September for the construction of a can manufacturing plant here, for Continental Can Co., 1 Pershing Sq., New York. Estimated cost $1,000,000. Noted Aug. 28.

N. J., Carteret—United States Metal Refining Co., ft. of Delamar Ave., will build a refining plant. Estimated cost $40,000. Private plans. Work will be done by separate contracts.

N. J., Deal—New Jersey Bell Telephone Co., 540 Broad St., Newark, awarded contract for the construction of a 1 story laboratory building here. Estimated cost $40,000.

N. J., Jersey City—Bergen Sq. Garage, c/o C. Shilowitz, 26 Journal Sq., Archt. is having plans prepared for the construction of a 5 story garage on Bergen Ave. Estimated cost $500,000.

N. J., Jersey City—Burstyn Heftler Corp., 821 Bergen Ave., rejected bids for an 8 story, 130 x 225 ft. garage at Bergen Ave. and Academy St. Estimated cost $450,000. C. Shilowitz, 26 Journal Sq., Archt. Noted Apr. 10.

N. J., Newark—R. C. Klemm, 944 Broad St., Archt., will receive bids about Oct. 1 for the construction of a 1 story, 25 x 100 ft. factory and garage at 1820-22 Oxford St. for A. Kaminski, c/o Archt. Estimated cost $40,000. Noted Sept. 4.

N. J., Newark—National Air Transport, 420 Lexington Ave., New York, plans the construction of a hangar and shops at municipal airport here. Estimated cost $100,000. R. H. Higgins, Chicago, c/o owner, architect.

N. Y., Auburn—Dept. of Correction, State Bldg., Capitol, Albany, will receive bids late in September for the construction of a foundry and shop building, etc. here. Estimated cost to exceed $40,000.

N. Y., Brooklyn—Dietrich Wortmann, 116 Lexington Ave., New York, Archts., is receiving bids for the construction of a 2 story, 100 x 299 ft. garage and shop at Henry and Calyes Sts. here for Standard Oil Co. of New York, 26 Broadway, New York. Estimated cost $160,000. Noted Mar. 13.

N. Y., Brooklyn—R. H. Macy & Co., 34th St. and Broadway, New York, awarded contract for a 153 x 256 ft. shop and garage at Glenwood Rd. and Schenectady Ave., here. Estimated cost $200,000. Noted Sept. 11.

N. Y., Brooklyn—J. F. McKenna, 58 Van Dyke St., will receive bids about Nov. 1, for the construction of a 150 x 200 ft. service garage at Columbia and Creamer Sts. Estimated cost $60,000. H. F. McLaughlin, 153 West 97th St., New York, Archt. Noted May 22.

N. Y., Jamaica—Felberose Holding Corp., 15 Twombly Pl., plans the construction of a 2 story service garage at Twombly Pl. and Jamaica Ave. Estimated cost $60,000. Private plans.

N. Y., Jamaica—Owner, c/o A. McLean, 149-27 Jamaica Ave., Archt., plans the construction of a 117 x 167 ft. service garage at Bellaire St. and Jamaica Ave. Estimated cost $40,000.

N. Y., Middle Village—F. T. Lang, 1790 Metropolitan Ave., will build a 2 story, 90 x 139 ft. service garage at Metropolitan and Juniper Aves. Estimated cost to exceed $40,000. Private plans. Work will be done by separate contracts.

N. Y., New York—F. Levy, 60 Wadsworth Ave., plans the construction of an automobile repair shop at West 176th St. and Broadway. Estimated cost $40,000. B. R. Swartburg, 2 West 46th St., Archt.

N. Y., New York—New York Central R.R., 466 Lexington Ave., plans the construction of a 10 story, 267 x 460 ft. service station, freight storage building, etc. at 59-97 West End Ave. Estimated cost $1,500,000. F. B. Freeman, New York, Ch. Engr. Eastern Division.

N. Y., New York—St. Johns Corp., 1350 Broadway, New York, plans the construction of a service garage at 281 Albany St. Estimated cost $150,000. S. Pelton, 110 West 42nd St., Archt. Maturity Jan. 1.

N. C., Asheville — H. P. Bloomberg, 141 Chestnut St., awarded contract for the construction of a garage and service station. Estimated cost $25,000.

Pa., Philadelphia—Philadelphia Coke Co., 45th and Richmond Sts., awarded contract for a 1 story, 65 x 320 ft. garage.

Pa., Somerset—Bd. of Education, I. J. Walker, Secy., East Union Ave., will receive bids until Sept. 22 for the construction of a 3 story, 123 x 148 ft. high school including manual training department, etc. Estimated cost $150,000. E. H. Walker & Mong, 226 East Church St., Archts.

Va., Altavista—The Lane Co., manufacturers of Lane cedar chests, is having plans prepared for rebuilding 3 story, 100 x 120 ft. warehouse recently destroyed by fire. Lockwood, Greene Engineers Inc., 100 East 42nd St., New York, Engrs.

Wis., Milwaukee—Crane Co., 836 South Michigan Blvd., Chicago, Ill., awarded contract for the construction of a 2 story, 74 x 200 ft. warehouse on Capitol Ave., here. Estimated cost $115,000. Noted May 8.

Wis., Milwaukee—A. O. Smith Corp., 27th and Keefe Sts., manufacturers of pressed and welded steel, awarded contract for the construction of a 1 story, 225 x 245 ft. factory on 27th St. Estimated cost $200,000.

Ont., Copper Cliff—International Nickel Co., awarded contract for remodeling and reconstructing old smelter into building to house refinery now at Port Colborne. Estimated cost $2,000,000.

Ont., Fort William—Bd. of Education, will soon receive bids for the construction of a new 3 story technical school. Estimated cost $400,000. R. E. Mason, Francis Block, Archt. Noted Apr. 24.

Ont., New Toronto — Anaconda American Brass Ltd., awarded masonry contract for 70 x 450 and 98 x 200 ft. additions to plant. Estimated cost $200,000. Noted Aug. 7.

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